# 8 Alternative-specific Risk Assessment

This section presents an analysis of the potential for risk reduction associated with the proposed remedial action levels presented in the previous two sections of the FS. Central to the selection of any potential remedy for the river and bay is the ability of the remedy to reduce or eliminate risks to human health and the environment. This evaluation includes both active remedial actions such as capping or removal, but also passive actions such as natural recovery and assumes that all remedial actions would have the same risk reduction at the same action level. For example, at a 250 ppb action level, capping achieves the same level of risk reduction as dredging. This Alternative-specific Risk Assessment (ASRA), therefore, is an action level-specific risk assessment.

The ASRA builds upon the risks, remedial action objectives, and remedial action levels defined in Sections 2, 3, 4, and 5 of the FS. Risks from exposure of humans and environmental receptors within the river and bay for PCBs were presented in the Baseline Risk Assessment for the Lower Fox River and Green Bay (BLRA) (Section 3). Sediment quality thresholds (SQTs) were also presented in the BLRA that, along with estimates of PCB mass and sediment volumes from the Remedial Investigation (Section 2), were used to define remedial action levels in Section 5.

Evaluation of residual risks associated with implementation of a specific remedial action level in sediments requires the ability to estimate the changes over time of total PCBs in water, sediment, and fish as a result of the action. None of the remedial action levels identified provide 100 percent protection immediately after remediation (or initiation of monitored natural recovery) for all of the human or ecological receptors in the Lower Fox River or Green Bay. The key assumption of remediation is that sediment transport and burial over time would achieve further reductions in risk. This is also applicable to the evaluation of passive remedial management; risk reduction under monitored natural recovery.

Mathematical fate, transport, and bioaccumulation models provide a means for estimating the changes in PCB concentrations over time. Using those projections, the level of estimated risk reduction and the time it takes to achieve that risk reduction, can be used as metrics for comparing the efficacy of the remedial action levels in each river reach and bay zone.

The subsections below define:

- What are the metrics for the RAOs used to evaluate risk reduction?
- What are the mathematical models used to project the levels of PCBs in water, sediment, and fish tissue concentrations over time?
- What remedial action levels, or combinations of action levels, are modeled?
- How do the projections for different action levels affect risk in each reach/zone (i.e., comparison against the RAOs)?
- Are there post-remedial risks for other chemicals of concern (COCs) identified in the BLRA (i.e., DDE and mercury)?

These questions provide the foundation for the ASRA. The RAO metrics, models, evaluation process, PCB risk reduction, and risk from other COCs are described below for each river reach and bay zone. It is emphasized here, and will be reiterated throughout this section, that risk reduction predictions are meant to be compared in a relative, and not an absolute sense. The relationship between the predictive models and the estimated PCB concentrations in both sediments and fish tissue are described in Table 8-1.

## 8.1 Remedial Action Objectives

for the Lower Fox River and Green Bay were defined in Section 4. WDNR and EPA articulated their project expectations into explicit, measurable statements (e.g., number of years to remove fish consumption advisories) in order to evaluate the expected performance of each alternative and each action level. The RAOs and project expectations were defined as follows:

- *RAO 1 - Achieve, to the extent practicable, surface water quality criteria throughout the Lower Fox River and Green Bay.*

  The metric for RAO 1 is that PCBs measured in surface waters are at or below surface water quality criteria. The values used for surface water quality are the human health value defined in NR 105 WAC for drinking water (0.003 ng/L) and wildlife (0.12 ng/L). The drinking water value is actually a surface water value protective of human health at a lifetime cancer risk level of $10^{-5}$ from the consumption of fish which bioaccumulate PCBs from surface waters. However, it should be noted

that these are not ARARs. Additionally, while not a specific criterion, the projected concentrations are also compared to current maximum outflow concentrations from Lake Winnebago.

- *RAO 2 - Protect humans who consume fish from exposure to COCs that exceed protective levels.*

  The metric for RAO 2 is stated as the removal of fish consumption advisories in the Lower Fox River and Green Bay. The metrics below are only one set of goals for risk management decision making, but are used in the FS for relative comparison between alternatives and action levels.

  - Recreational anglers can safely eat fish 10 years after completion of a remedy; and

  - High-intake fish consumers can safely eat fish 30 years after completion of a remedy.

  Within the BLRA, human health risks were estimated for multiple potential exposure scenarios. These included recreational and high-intake fish consumers, risk levels for cancer ranging from $10^{-4}$ to $10^{-6}$, and a noncancer HI of 1.0, for both the Reasonable Maximum Exposure (RME) and the Central Tendency Exposure (CTE). A threshold based on a $10^{-5}$ cancer risk level indicates that individuals eating fish with this threshold concentration over a lifetime could contract cancer at the rate of one case in 100,000 people. A threshold based on an HI of 1.0 indicates individuals eating fish with this threshold concentration over a lifetime should not experience any adverse noncancer effects. These risks were expressed in Section 7.4.2 of the BLRA in terms of safe total PCB levels in whole walleye, yellow perch, and carp. For the ASRA, the time to achieve these human health fish tissue thresholds by action level was estimated using model projections.

  For the evaluation and comparison of risk under different action levels, four whole fish thresholds were selected by WDNR and EPA for the protection of human health:

  - Recreational angler - walleye, RME, HI is 1.0 (noncancer) (288 $\mu$g/kg);

- Recreational angler - walleye, RME, $10^{-5}$ cancer risk (106 $\mu$g/kg);
- High-intake fish consumer - walleye, RME, HI is 1.0 (noncancer) (181 $\mu$g/kg); and
- High-intake fish consumer - walleye, RME, $10^{-5}$ cancer risk (65 $\mu$g/kg).

Human health risks in the BLRA were based upon consumption of fillets. As the models (FRFood and GBFood) predict whole fish tissue PCB concentrations, it was necessary to establish fillet-to-whole body ratios from the FRDB and the scientific literature. The relationship between fillets and whole body concentrations is given in Table 8-2.

This does not imply other risk levels could not be used for risk management; these risk levels and time frames are used simply for consideration and comparison between remedial options, along with other evaluation criteria. Additional risk thresholds are used for comparison over time as discussed in later portions of this section.

- *RAO 3 - Protect ecological receptors from exposure to COCs above protective levels.*

  In the BLRA, ecological risks were estimated for specific receptor/receptor groups (e.g., benthic infauna, fish, piscivorous birds). Concentrations of total PCBs in water, sediment, or fish known to affect the selected receptors were used to calculate apparent risks. This included both the "No Observed Apparent Effect Concentration" (NOAEC) and the "Lowest Observed Apparent Effect Concentration" (LOAEC). For the affected fish, bird, and mammal groups, NOAEC and LOAEC risks can be expressed as total PCB threshold concentrations in whole fish (carp, walleye, alewife, shiners, shad). The relationship between the NOAEC/LOAEC, fish tissue concentration, and sediment concentration is defined in Section 7.4.3 of the BLRA.

  For the ASRA, the time to achieve these ecological whole fish thresholds for a specific action level was estimated using model projections (discussed below). For the evaluation and comparison of risk under different action levels, two ecological thresholds were selected by both WDNR and EPA:

- Carnivorous bird deformity - NOAEC based on carp, whole fish (121 μg/kg); and

- Piscivorous mammal - NOAEC based on carp, whole fish (50 μg/kg).

While these are only potential metrics, these values were compared to an equivalent time period to the high-intake fish consumer (30 years post-remediation) with the potential goal that there would be no risk to these receptors within this time frame following remediation. These RAOs are simply used to compare remedial options on the same basis. However, additional thresholds are used for comparison over time in later sections.

- *RAO 4 - Reduce transport of PCBs from the Lower Fox River into Green Bay and Lake Michigan.*

  While mass is not specifically related to risk, it is a metric for transport of risk downstream. Mass transport will be presented qualitatively as a comparison between specific action levels, but is only applied to the last reach of the river, De Pere to Green Bay. The last reach accounts for all of the mass transport from materials upstream and downstream of the De Pere dam. Between action levels, projected sediment loading will be compared to 30 years total. In addition, the Lake Winnebago loading rate (18 kg/yr) and the other tributaries to Green Bay loading rate (10 kg/yr) will be used to compare action level results over time. Loading rates from all sources are presented in Section 5.1 of the RI Report (RETEC, 2002a).

- *RAO 5 - Minimize the downstream movement of PCBs during implementation of the remedy.*

  This RAO was evaluated in Sections 6 and 7 of the FS, and will not be further discussed here.

In summary, the metrics lists above are used for relative screening of alternatives, but may not necessarily be the same criteria used to select a final remedy by the resource agencies. Expectations may change or be revised over the course of the project and through the public review process, but for now, they initially provide a useful framework to compare and evaluate the action levels. They also provide performance criteria that can be used as measurement tools during development of the *Long-term Monitoring Plan* (Appendix C). RAOs 1 through 3 are applied to

all river reaches. For Green Bay, only RAOs 2 and 3 were evaluated. RAO 4 is applied only to the De Pere to Green Bay Reach.

## 8.2 Lower Fox River/Green Bay Modeling

Computer models have been developed and used in the FS to project changes in total PCBs in water, sediment, and fish over time. These models are mathematical representations of transport and transfer of PCBs between the sediments, water, and uptake into the food webs described in Section 3 of the FS. While the models discussed below are useful for comparing between potential action alternatives, there should be no mistaking that utility for precision. All the models are calibrated over a short time frame (6 years or less), but projected over 100 years. While there is a reasonable assurance that the relative trends are accurate, there are no assurances that the predictions are precise. In other words, comparisons are relatively reliable, but absolute estimates may not be accurate and should not be strictly relied upon.

The relationship between the models, their projected output, and how the output is used in evaluating risks, is shown in Table 8-1. The bed maps produced as part of the Remedial Investigation are the foundation of the modeling inputs. The surface sediment total PCB concentrations for the baseline and action levels discussed in Section 5 are used as the inputs to both hydrodynamic models: the Whole Fox Lower River Model (wLFRM) and the Enhanced Green Bay Toxics Model (GBTOXe). These two models project total PCB concentrations in water and sediment which are used to evaluate risks as defined in RAOs 1 and 4. The output from the two fate models are used by the bioaccumulation models: Fox River Food (FRFood) and Green Bay Food (GBFood). The projected whole fish tissue concentrations of PCBs are used to evaluate risks as defined in RAOs 2 and 3.

The structure of each of these models is briefly described below. A complete description of all the models used in the RI and FS is given in the companion document *Model Documentation Report for the Lower Fox River and Green Bay* (WDNR, 2001). The uncertainties associated with the predictions of long-term residual risks need to be considered. The uncertainties associated with the selection of specific receptors and the thresholds at which those receptors are thought to be placed at risk are discussed in the BLRA. Model uncertainties include the assumptions built into the mass transport models used to predict long-term water and sediment trends, and the associated risks for those river reaches and Green Bay zones. These uncertainties are discussed in Section 8.5.

### 8.2.1 Whole Lower Fox River Model (wLFRM)

The Whole Lower Fox River Model (wLFRM) was developed by WDNR from two models previously developed for the analysis of flow in the Lower Fox River: the Upper Fox River (UFR) model, which covered the river between Lake Winnebago and the De Pere dam; and the Lower Fox River (LFR) model, which extended from the De Pere dam to the mouth of the river. The wLFRM retains the spatial resolution of the UFR/LFR models, but allows the simulation of the entire Lower Fox River from Lake Winnebago to the mouth of the river using a single model. The wLFRM is calibrated with data collected between 1989 and 1995. Calibration consisted of comparisons between the data and model results for total suspended solids, dissolved/particulate PCBs in water, sediment bed elevation, and net sediment burial rate.

The wLFRM is used to simulate the fate and transport of solids and PCBs in the water and sediments in the Lower Fox River. The model predicts the movement of solids and PCBs among these various model segments. In addition, the model simulates the concentration of organic carbon in the water column. Transport mechanisms in the wLFRM include advection, dispersion, volatilization, deposition, and resuspension. Deposition is a function of particle size or density with different settling rates to represent sand-, silt-, and clay-size particles. The settling rate for clay-size particles can also be used to simulate the settling of low-density organic matter. Resuspension is based on surface water velocity and the effect of sediment bed armoring over time.

The results from the wLFRM are used as input to other the three models. Area-weighted average concentrations of total PCBs and carbon in water and sediments are output for the bioaccumulation models. Results from above the De Pere dam are used as input to the FRFood model. Results from below the De Pere dam to the mouth of the river are used as input to both the FRFood and GBFood models. Finally, the predicted solids and PCB discharges at the mouth of the river are used as inputs to the GBTOXe model. Each of these three models is discussed below.

### 8.2.2 Enhanced Green Bay Toxics(GBTOXe) Model

The Enhanced Green Bay Toxics Model (GBTOXe) was developed by HydroQual to simulate the fate and transport of PCBs in Green Bay for the RI/FS. GBTOXe is an enhanced version of an existing WASP4-based toxics model developed as part of the Green Bay Mass Balance Study by Bierman *et al.* (1992) and updated by DePinto *et al.* (1993). Enhancements include a higher spatial resolution and linkage to a hydrodynamics model (GBHYDRO) and a sediment transport model (GBSED) of Green Bay. GBTOXe was calibrated against 1989–1990 GLNPO PCB and carbon data.

GBTOXe is used to model total PCBs and three phases of carbon in the water column and sediments. The carbon phases considered are dissolved, biotic, and particulate detritus. Modeled sediment layers represent biologically active sediments, biologically inactive sediments, and a sink to which PCBs are permanently buried through deposition. Sediment segment volumes are assumed to be constant with time. PCB transport mechanisms include advection, dispersion, volatilization, deposition, resuspension of sorbed phase, and pore water exchange. GBTOXe accounts for sediment bed armoring. Output from GBTOXe includes area-weighted (sediments) or volume-weighted (water column) averages of total PCBs and carbon as input to the bioaccumulation models.

### 8.2.3 Fox River Food (FRFood) Model

The FRFood bioaccumulation model, based on the Gobas model (1993), is a mathematical description of PCB transfer within the food web of the Lower Fox River and the first two zones of Green Bay (zones 1 and 2). The model is designed to take the output of sediment and water concentrations of PCBs from wLFRM and GBTOXe to estimate concentrations in multiple trophic levels in the aquatic food web (i.e., benthic insects, phytoplankton, zooplankton, and fish). This food web model is functionally similar to, and spatially overlaps with, the food web model for Green Bay (GBFood), with the exception that the FRFood model can be run in reverse where the inputs are fish concentrations and the outputs are predicted sediment concentrations.

FRFood is based upon the algorithms originally developed for Lake Ontario PCBs (Gobas, 1993). Since then, the model has been used extensively throughout the Great Lakes, including derivation of bioaccumulation factors, bioconcentration factors, and food chain multipliers in the development of the Great Lakes Water Quality Initiative (GLWQI) criteria (EPA, 1993, 1994a, 1994b). The model was first used for projecting sediment quality thresholds in the 1996 RI/FS for the Upper Fox River (GAS/SAIC, 1996), and has since been used for setting action levels at the Sheboygan River (EVS, 1998), and for predicting long-term effects on biota at the Hudson River, New York (EPA, 2000c).

FRFood is used to estimate PCB concentrations in the food webs leading to forage fish (e.g., shiners, gizzard shad, alewife), benthic fish (e.g., carp), and game fish (perch, walleye) in the river. Water column and sediment PCB concentrations were provided by wLFRM. The model was calibrated using site-specific data from the Fox River Database (FRDB), and from scientific literature-derived values for the various physiological, bioenergetic, and toxicokinetic parameters in the model. FRFood was also used to estimate sediment quality thresholds of Section 7 of the BLRA.

### 8.2.4 Green Bay Food (GBFood) Model

The GBFood bioaccumulation model is a mathematical description of contaminant transfer within the food web of Green Bay zones 1 through 4. The food web is comprised of the primary energy transfer pathways from the exposure sources (sediment and water) to the fish species of interest, described in Section 4.4. These pathways include: chemical uptake across the gill surface, chemical uptake from food and chemical losses due to excretion, and growth dilution. The mathematical descriptions are generic (common to all aquatic food webs) and were updated as part of this FS.

GBFood is used in the ASRA to estimate PCB concentrations in the food webs leading to brown trout and walleye in zones 2 through 4 of Green Bay. Carp were not evaluated in GBFood as the model was not constructed to include that fish. This was accomplished by specifying values for the various physiological, bioenergetic, and toxicokinetic parameters in the model and the PCB exposure levels in sediments and water. The parameter values were derived from peer-reviewed studies published in the literature and/or site-specific data. The sediment and water column PCB concentrations were provided by wLFRM and GBTOXe model outputs.

## 8.3 Description of Detailed Analysis Process

### 8.3.1 Lower Fox River and Green Bay Total PCB Residual Risk Evaluation

Remedial action levels considered for each of the river reaches include no action, 125, 250, 500, 1,000, and 5,000 ppb. Action levels for the FS were discussed in Section 5. The discussion of action levels relative to the process options (i.e., hydraulic dredging, capping, etc.), the quantity of contaminated sediment, and costs will be discussed in Section 10. Only residual risks associated with implementation of a specific action level are discussed in this section. The residual risks associated with no action are discussed in the BLRA, and the non-interpolated total PCB sediment concentrations that were evaluated as part of this assessment are presented in Table 8-3 by river reach and bay zone.

For modeling in the FS, the same action levels were applied to each river reach. For example, under the No Action alternative the models were run assuming that no action had occurred on all four river reaches.

Unlike the river, not all remedial action levels are considered for Green Bay and not all areas of Green Bay are considered for remediation. Remedial action levels carried forward in the transport model for Green Bay zones 2 and 3A included

500 and 1,000 ppb, the only remedial action level considered for Green Bay Zone 3B was 500 ppb, and no remedial action was considered for Green Bay Zone 4.

Finally, remedial action levels evaluated for each bay zone considered the potential for different remedial actions between the river and the bay. Remedial combinations for modeling were selected by WDNR as shown below:

| Lower Fox River Cleanup Level (ppb) | Green Bay | | |
|---|---|---|---|
| | No Action | 500 | 1000 |
| No Action | ✓ | — | — |
| 125 | ✓ | ✓ | ✓ |
| 250 | ✓ | ✓ | ✓ |
| 500 | ✓ | ✓ | ✓ |
| 1000 | ✓ | — | ✓ |
| 5000 | ✓ | — | — |

## 8.3.2 Non-PCB COC Residual Risk Evaluation

In addition to total PCBs, residual post-remediation risk results from the other two chemicals of concern (COCs) identified in the BLRA, mercury and DDD/DDE/DDT, were evaluated for each remedial action level immediately following remediation. The risks to human health and the environment from these other COCs were most often much less than those posed by PCBs. For clarification, in general mercury was measured above risk levels in both sediments and tissues. DDD and DDT were measured above risk levels in sediment, however, only DDE was measured above risk levels in tissues.

As discussed above, the primary tool for evaluating residual PCB exposure assuming different action levels was modeling surface water, sediment, and wildlife tissue concentrations over a 100-year period following remediation. In contrast, the primary tool for evaluating residual mercury and DDD/DDE/DDT exposure was simply the degree of co-location with removed PCBs in the sediment. The degree of this co-location was determined by plotting the distribution of the compounds in the FRDB relative to the total PCB base maps and the locations of sediments to be addressed as identified in Section 5. The implementation of the alternatives described in Section 7 is assumed to result in the removal or isolation of the non-PCB contaminants along with the PCBs assuming that all of the COCs are co-located. The no action alternatives result in the same residual risks as those identified in the BLRA. No action sediment concentrations of mercury, p,p'-DDD, p,p'-DDE, and p,p'-DDT are presented in Table 8-4. Residual risks to human health and the environment may remain for

the action levels that do not remove all areas of contaminated sediment and these are discussed in the reach and zone discussions below. Residual surface sediment concentrations of mercury and DDE as they relate to residual PCB levels by action level are presented on Figures 8-1 through 8-8 for the Lower Fox River and Figures 8-9 and 8-10 for Green Bay.

## 8.4 Reach- and Zone-specific Risk Assessment

This section discusses the long-term future residual risk associated with each remedial action level, or combination of remedial action levels, in each of the river reaches and bay zones evaluated. Specifically, the associated risks are discussed in terms of the number of years needed before the specific goals of the RAOs outlined above in Section 8.1 are met. RAOs 1 and 4 are not evaluated for any of the Green Bay zones.

Long-term residual risk in the river was determined through using the wLFRM model to derive future water and sediment concentrations and the FRFood model to derive future fish tissue concentrations. Similarly, long-term residual risk in the bay was determined through the GBTOXe model to derive future water and sediment concentrations and the GBFood model to derive future fish tissue concentrations.

***RAO 1: Water Quality.*** For the evaluation of RAO 1, projected surface water total PCB concentrations for each action level were compared to selected thresholds (Table 8-5). The thresholds for surface water, as previously discussed, are the Wisconsin NR 105 water (0.003 ng/L) and wildlife criteria (0.12 ng/L), and the current maximum concentration measured in Lake Winnebago (13 ng/L). These thresholds are compared to the modeled concentrations for each river reach and action level.

The potential risk management goal of meeting human health and ecological thresholds for RAOs 2 and 3 is no risk to any receptors 30 years after remediation has been completed. For consistency, the surface water concentrations 30 years after remediation were noted and compared between action levels. The number of years to reach the surface water thresholds and the surface water concentrations 30 years after remediation are presented in Table 8-5.

***RAO 2 and RAO 3: Human Health and Ecological Risk:*** Human health receptors considered were recreational anglers and high-intake fish consumers. Ecological receptors evaluated included: carp as the surrogate representative for benthic fish, walleye as the surrogate representative of pelagic fish, Forster's terns as the surrogate representative of piscivorous birds, bald eagles as the surrogate

representative of carnivorous birds, and mink as the surrogate representative for piscivorous mammals. For the four river reaches and four Green Bay zones, human health and ecological thresholds evaluated by action level are presented in Tables 8-6 through 8-9 and Tables 8-10 through 8-13, respectively.

For the initial evaluation of RAOs 2 and 3, all human health and ecological risk thresholds evaluated in the baseline risk assessment were included: 30 human health thresholds and 15 ecological thresholds. As previously discussed, the risk levels of the human health thresholds were a noncancer HI of 1.0, and cancer risk levels of $10^{-4}$, $10^{-5}$, and $10^{-6}$. The risk levels of the ecological thresholds were NOAECs and LOAECs.

For the final evaluation of RAOs 2 and 3 risks presented in this section, the focus was on just a few select human health and ecological thresholds which were selected by WDNR and EPA: four human health and seven ecological thresholds. For human health, these thresholds were the RME concentration in walleye assuming consumption by recreational anglers and high-intake fish consumers at a noncancer HI of 1.0, and at a cancer risk level of $10^{-5}$ (i.e., four thresholds total). These human health thresholds (RAO 2) and the years required to meet them assuming different action levels are contained in Table 8-14 (Lower Fox River) and Table 8-15 (Green Bay). The ecological thresholds selected for discussion were the sediment threshold for sediment invertebrates (only evaluated in the river reaches) and the following whole fish tissue thresholds: gizzard shad or alewife concentrations resulting in no or low adverse hatching success or deformity in piscivorous birds, the carp (river) or walleye (bay) concentrations resulting in no adverse deformities in carnivorous birds, and the carp (river) or walleye or alewife (bay) concentrations resulting in no adverse reproductive or survival effects on piscivorous mammals. These ecological thresholds (RAO 3) and the years required to meet them assuming different action levels are contained in Table 8-16 (Lower Fox River) and Table 8-17 (Green Bay). As stated previously, there are potential risk management goals used in the FS. Alternate management goals may be selected by WDNR and EPA.

For each river reach and bay zone, the number of years to reach these human health and ecological remedial action objective thresholds are discussed below. With each decrease in remedial action level, there is a corresponding decrease in the number of years that it takes to meet a threshold. Overall goals of the remedial action level(s) are that recreational anglers will be able to eat walleye within 10 years following remediation with no cancer or noncancer risks, that high-intake consumers will be able to eat walleye within 30 years following remediation with no cancer or noncancer risks, and that there will be no adverse risks to ecological receptors within 30 years following remediation. Based on

these potential remedial goals, action levels that achieve these goals are summarized in the conclusion of each reach/bay discussion below.

Although this risk analysis is useful for comparing relative residual risk resulting from each action level and for comparing the relative risk between areas, there are inherent uncertainties associated with the magnitude of residual risk projected 100 years into the future and, therefore, the number of years required to meet the stated remedial action objectives. For example, while the baseline human health and ecological risk assessment concluded that there are potential risks to piscivorous birds, the forward projection of these risks suggests that in the Little Lake Butte des Morts and Appleton to Little Rapids reaches and for all remedial action levels, risks to piscivorous birds do not persist for more than 1 year, even for the No Action alternative. In the Little Rapids to De Pere and De Pere to Green Bay reaches, the only piscivorous bird threshold that is not met within 1 year is the no deformity threshold. A full discussion of this and other uncertainties associated with the forward projection of sediment and fish tissue concentrations and assessment of residual risk is presented in Section 8.5. In part, to address these uncertainties a monitoring program following remediation will be implemented as described in Appendix C.

***RAO 4: Mass Transport to Green Bay.*** For RAO 4, projected mass loads by action levels at the mouth of the Fox River were compared to the background total PCB loadings identified in the Remedial Investigation. The PCB loading rate to the Lower Fox River from Lake Winnebago is 18 kg/yr. The combined loading rate for all tributaries to Green Bay is estimated at 102 kg/yr (see RI Section 5.1.2.1). Overall, the sediment PCB loading discussion focused on comparing relative reductions in sediment loading with each increase in the action level applied. The sediment PCB loading rates 30 years after remediation are presented in Table 8-18.

## 8.4.1 Little Lake Butte des Morts

### Residual PCB Levels

**RAO 1 - Surface Water Quality.** As presented in Table 8-5, the surface water criteria of 0.003 ng/L are projected to never be met no matter what action level is selected. The wildlife criteria of 0.12 ng/L is not met within 100 years for either the no action or 5,000 ppb action level, yet it is projected to be met within 100 years for the other action levels: 52 years (1,000 ppb), 39 years (500 ppb), 19 years (250 ppb), and 16 years (125 ppb). As compared to the Lake Winnebago current maximum concentration of PCBs in surface water (13 ng/L), under the No Action

alternative this concentration is met within 4 years, under an action level of 5,000 ppb this concentration is projected to be met within 1 year,[4] and for all of the other action levels, this concentration is met immediately following remediation. Thirty years after remediation, it is estimated that surface water total PCB concentrations range from 0.04 ng/L (125 ppb) to 2.99 ng/L (no action).

**RAO 2 - Human Health.** As indicated in Table 8-14, remedial action levels as high as 1,000 ppb are projected to result in the attainment of fish threshold concentrations within 1 year following remediation. For noncancer risks, fish thresholds are estimated to be met within a year up to a remedial action level of 1,000 ppb. Noncancer risks at the 5,000 ppb action level represent a risk reduction of approximately 40 percent as compared to no action. For cancer risks, the only remedial action levels that result in fish thresholds being met within a year are the 250 and 125 ppb action levels. As compared to the No Action alternative, the projected 5,000, 1,000, and 500 ppb action levels result in a cancer risk reduction of approximately 31, 87, and 92 percent, respectively.

For the 125 and 250 ppb action levels, all fish thresholds except the high-intake fish consumer cancer risk threshold (71 $\mu$g/kg) are projected to be met in less than a year. For the 500 ppb action level, within 1 year there are no noncancer risks to recreational anglers and high-intake fish consumers; however, cancer risks persist for 5 years (recreational intake) to 10 years (high intake). For the 1,000 ppb action level, noncancer risks are estimated to persist for less than 1 year (recreational angler) to 4 years (high-intake fish consumer); cancer risks persist for 9 years (recreational angler) to 14 years (high-intake fish consumer). For the 5,000 ppb action level projections, noncancer risk of fish consumption persists for 29 years (recreational intake) to 40 years (high intake) and cancer risk of fish consumption persists for 57 years (recreational intake) to 70 years (high intake). For the No Action alternative, noncancer risks of fish consumption are estimated to persist for 51 years (recreational intake) to 65 years (high intake) and cancer risk of fish consumption persists for 84 years (recreational intake) to 100 years (high intake).

With the goals in mind of 10 years for safe fish consumption by recreational anglers and 30 years for safe fish consumption by high-intake consumers, only projections for remedial action levels of 1,000 ppb or less result in meeting these goals. The 1,000 and 500 ppb action levels differ by approximately 37 percent

[4] A projection of "1 year following remediation" is a model output, and should not necessarily be literally interpreted. PCBs will remain at a steady level in the current age population of fish for 3 to 6 years. The next generation of fish would show the projected PCB reduction. Thus, while the model projects risk reduction in 1 year, in the real world this would be up to 6 years.

and the 125 and 250 ppb action levels do not differ, in terms of the level of risk reduction achieved.

**RAO 3 - Ecological Health.** As indicated in Table 8-16, the range of remedial action levels are projected to result in either thresholds being met within a year following remediation (i.e., carnivorous bird deformity assuming the 250 or 125 ppb action level and all piscivorous bird thresholds at all action levels), or thresholds not being met within 100 years (i.e., sediment concentrations protective of sediment invertebrates assuming no action or a remedial action level of 5,000 ppb and the piscivorous mammal NOAEC assuming no action). As compared to the 5,000 ppb action level, other action level projections result in a risk reduction to carnivorous birds of 79 percent (1,000 ppb action level) and 87 percent (500 ppb action level), and a risk reduction to piscivorous mammals of 71 percent (1,000 ppb), 75 percent (500 ppb), 91 percent (250 ppb), and 93 percent (125 ppb). As compared to the 1,000 ppb action level, the projections for other action levels result in a risk reduction to sediment invertebrates of 13 percent (500 ppb), 57 percent (250 ppb), and 65 percent (125 ppb).

Estimates for the attainment of the carnivorous bird threshold under action levels which result in risk for more than 1 year ranges from 9 years (500 ppb action level) to 100 years (no action). Attainment of the piscivorous mammal threshold ranges from 7 years (125 ppb action level) to more than 100 years (no action). The sediment invertebrate threshold is only met within 100 years for remedial action levels of 1,000 ppb or less, where achieving this threshold ranges from 21 years (125 ppb action level) to 60 years (1,000 ppb action level).

With the goal in mind of 30 years for no adverse ecological risks, only remedial action levels of 250 or 125 ppb result in meeting this goal. The 250 and 125 ppb action levels only differ by approximately 3 percent in terms of the level of risk reduction achieved. The action levels of 5,000, 1,000, and 500 ppb do not result in achievement of the stated goal, and the 125 ppb action level is not appreciably more protective than the 250 ppb action level.

**RAO 4 - Sediment Transport.** As presented in Table 8-18, 30 years following remediation, the sediment PCB loading rates for the action levels as compared to the No Action alternative represent sediment PCB loading reductions of 44 percent (5,000 ppb), 94 percent (1,000 ppb), 96 percent (500 ppb), 98 percent (250 ppb), and 99 percent (125 ppb). Compared to the Lake Winnebago sediment PCB loading rate of 18 kg/yr, the No Action alternative results in meeting this rate in 17 years, the 5,000 ppb action level results in meeting this rate in 7 years, and for all of the other action levels this rate is met immediately following remediation.

### Residual Mercury and DDE Levels

The distribution and concentrations of mercury and DDE in sediments and degree of co-location with PCBs within the Little Lake Butte des Morts Reach are shown on Figure 8-1 (mercury and PCBs) and Figure 8-2 (DDE and PCBs). These figures clearly indicate that mercury and DDE are both extensively co-located with PCBs.

The only area which contains mercury, but not PCBs, is the eastern side of this reach near the connection with Lake Winnebago. Regardless of the remedial action level selected, mercury concentrations here remain in the range of 1 to 5 mg/kg. Even with no remedial action in this reach, mercury concentrations do not exceed 5 mg/kg. These residual concentrations of mercury may pose a risk to water column and benthic invertebrates as well as piscivorous birds.

Under the No Action alternative, DDE concentrations may be more than 1,000 $\mu$g/kg. Under the 5,000 ppb action level, DDE concentrations drop to 25 to 100 $\mu$g/kg and these DDE concentrations in sediment are still present, although smaller in area, under the 1,000 and 500 ppb action alternatives. At the 250 and 125 ppb action levels, no DDE is present in the sediment. Because all areas of DDE contamination are co-located with PCBs, residual risk from DDE will not exceed residual risks from PCBs.

### Conclusion

Based upon the evaluations presented above, the remedial action levels of 1,000 and 250 ppb will meet the stated goals of the RAOs.

## 8.4.2 Appleton to Little Rapids

### Residual PCB Levels

**RAO 1 - Surface Water Quality.** As presented in Table 8-5, the drinking water criteria of 0.003 ng/L is never met no matter what action level is selected. The wildlife criteria of 0.12 ng/L is not met within 100 years for either the no action or 5,000 ppb action level, yet it is met within 100 years for the other action levels: 52 years (1,000 ppb), 40 years (500 ppb), 21 years (250 ppb), and 19 years (125 ppb). As compared to the Lake Winnebago current maximum concentration of PCBs in surface water (13 ng/L), under the No Action alternative this concentration is met within 4 years, and for all of the other action levels this concentration is met immediately following remediation. Thirty years after remediation, surface water total PCB concentrations range from 0.04 ng/L (125 ppb) to 2.76 ng/L (No Action).

**RAO 2 - Human Health.** As indicated in Table 8-14, projections for remedial action levels as high as 1,000 ppb can result in the attainment of fish threshold concentrations within 1 year[5] following remediation. For noncancer risks, fish thresholds are met within 1 year following remediation up to a remedial action level of 250 ppb for recreational anglers. As compared to the No Action alternative, the 5,000, 1,000, and 500 ppb action level projections result in a noncancer risk reduction of approximately 34, 89, and 91 percent, respectively. Cancer thresholds are not met within 1 year. As compared to the No Action alternative, the 5,000, 1,000, 500, 250, and 125 ppb action levels result in a cancer risk reduction of approximately 37, 80, 83, 90, and 92 percent, respectively.

For the 125 ppb action level, there are no noncancer risks within 1 year, and cancer risks are estimated to persist for 5 years (recreational intake) to 8 years (high intake). For the 250 ppb action level, noncancer risks persist for less than 1 year (recreational intake) to 2 years (high intake) and cancer risks persist for 7 years (recreational intake) to 9 years (high intake). For the 500 ppb action level, within 1 year there are no estimated noncancer risks to recreational anglers, but high-intake fish consumer noncancer risks persist for 5 years. For the 1,000 ppb action level, noncancer risks persist for 4 years (recreational intake) to 7 years (high intake) and cancer risks persist for 14 years (recreational intake) to 17 years (high intake). For the 5,000 ppb action level, noncancer risks persist for 26 years (recreational intake) to 37 years (high intake), and cancer risks persist for 42 years (recreational intake) to 65 years (high intake). For the No Action alternative, noncancer risks persist for 40 years (recreational intake) to 55 years (high intake), and cancer risks persist for 70 years (recreational intake) to 89 years (high intake).

With the goals in mind of 10 years for safe fish consumption by recreational anglers and 30 years for safe fish consumption by high-intake consumers after completion of an active remedy, only a remedial action level of 500 ppb or less result in meeting these goals. The 500, 250, and 125 ppb action levels only differ by approximately 6 percent in terms of the level of risk reduction achieved. Effectively, therefore, an action level of 500 ppb may be appropriate for this reach and this RAO. The action levels of 5,000 and 1,000 ppb never meet the stated goals, and the 250 and 125 ppb action levels are not appreciably more protective than the 500 ppb action level.

[5] A projection of "1 year following remediation" is a model output, and should not necessarily be literally interpreted. See footnote 1 in Section 8.4.1, RAO 3 for a discussion.

**RAO 3 - Ecological Health.** As indicated in Table 8-16, the range of remedial action level projections results in thresholds being met within 7 to 100 years following remediation, with the exception of piscivorous mammal thresholds which are met in less than 1 year for all action levels. As compared to no action, the 5,000, 1,000, 500, 250, and 125 ppb action levels, respectively, result in an estimated risk reduction of 23, 76, 79, 87, and 90 percent for carnivorous birds, respectively; a risk reduction of 11, 66, 71, 82, and 85 percent for piscivorous mammals, respectively; and a risk reduction of 22, 65, 71, 80, and 84 percent for sediment invertebrates, respectively. Attainment of the carnivorous bird threshold ranges from 7 years (125 ppb action level) to 71 years (No Action). Attainment of the piscivorous mammal and sediment thresholds range from 15 years (125 ppb action level) to 100 years (No Action).

With the goal in mind of 30 years for no adverse ecological risks, only a remedial action level of 500 ppb or less is projected to meet this goal. The 1,000 and 500 ppb, and 250 and 125 ppb action levels only differ by approximately 7 and 5 percent, respectively, in terms of the level of risk reduction achieved. The 500 and 250 ppb action levels differ by approximately 50 percent in terms of the level of risk reduction achieved. The 250 and 125 ppb action levels differ by approximately 8 percent in terms of the level of risk reduction achieved. Therefore, an action level of either 500 or 250 ppb may be appropriate for this reach and this RAO. The action levels of 5,000 and 1,000 ppb never result in the achievement of the stated goal, and the 125 ppb action level is not appreciably more protective than the 250 ppb action level.

**RAO 4 - Sediment Transport.** As presented in Table 8-18, 30 years following remediation the sediment PCB loading rates for the action levels as compared to the No Action alternative represent sediment PCB loading reductions of 42 percent (5,000 ppb), 93 percent (1,000 ppb), 95 percent (500 ppb), 98 percent (250 ppb), and 99 percent (125 ppb).

## Residual Mercury and DDE Levels

The distribution and concentrations of mercury and DDE and degree of co-location with PCBs within the Appleton to Little Rapids Reach are shown on Figure 8-3 (mercury and PCBs) and Figure 8-4 (DDE and PCBs). These figures indicate that mercury and DDE are predominantly co-located with PCBs, but that there is one area at which mercury and DDE are both located, but not PCBs. Additionally, much of the PCB sediment contamination in this reach has already been remediated.

The only area which contains mercury and DDE is a small area in the middle of the reach located on the eastern side of the river. Regardless of the remedial

action level, mercury concentrations in this area are approximately 1 to 5 mg/kg and DDE concentrations are approximately 25 to 100 μg/kg. These concentrations suggest no risk from DDE, but the potential risk of mercury to sediment invertebrates, as well as piscivorous and carnivorous birds.

### Conclusion

Based upon the evaluations presented above, the remedial action levels of 500 and 250 ppb will meet the stated goals of the RAOs for this reach.

## 8.4.3 Little Rapids to De Pere

### Residual PCB Levels

**RAO 1 - Surface Water Quality.** As presented in Table 8-5, the drinking water criteria of 0.003 ng/L is never met no matter what action level is selected. The wildlife criteria of 0.12 ng/L is not met within 100 years for either the no action or 5,000 ppb action level, yet it is met within 100 years for the other action levels: 65 years (1,000 ppb), 54 years (500 ppb), 40 years (250 ppb), and 27 years (125 ppb). As compared to the Lake Winnebago current maximum concentration of PCBs in surface water (13 ng/L), under the No Action alternative this concentration is met within 9 years, under an action level of 5,000 ppb this concentration is met within 2 years, and for all of the other action levels this concentration is met immediately following remediation. Thirty years after remediation, surface water total PCB concentrations range from 0.08 ng/L (125 ppb) to 5.37 ng/L (no action).

**RAO 2 - Human Health.** As indicated in Table 8-14, no remedial action level estimates result in the attainment of fish threshold concentrations within 1 year following remediation and assuming no action, the only threshold that is met in less than 100 years is the recreational angler noncancer risk threshold (288 μg/kg). For noncancer risks, fish thresholds are met within 1 year[6] following remediation up to a remedial action level of 125 ppb for high-intake fish consumers, and up to a remedial action level of 500 ppb for recreational anglers. As compared to the 5,000 ppb action level, the 1,000, 500, 250, and 125 ppb action levels result in a noncancer risk reduction of approximately 79, 86, 93, and 95 percent, respectively. As compared to the 5,000 ppb action level, the 1,000, 500, 250, and 125 ppb action levels result in a cancer risk reduction of approximately 62, 74, 83, and 88 percent, respectively.

[6] A projection of "1 year following remediation" is a model output, and should not necessarily be literally interpreted. See footnote 1 in Section 8.4.1, RAO 3 for a discussion.

For the 125 ppb action level, noncancer risks are estimated to persist for 2 years (recreational intake) to 4 years (high intake), and cancer risks persist for 9 years (recreational intake) to 15 years (high intake). For the 250 ppb action level, noncancer risks are estimated to persist for 2 years (recreational intake) to 7 years (high intake) and cancer risks are estimated to persist for 14 years (recreational intake) to 20 years (high intake). For the 500 ppb action level, the noncancer risks are estimated to persist for 5 years (recreational intake) to 12 years (high intake) and cancer risks are estimated to persist for 20 years (recreational intake) to 29 years (high intake). For the 1,000 ppb action level, noncancer risks are estimated to persist for 9 years (recreational intake) to 17 years (high intake) and the cancer risks are estimated to persist for 30 years (recreational intake) to 42 years (high intake). For the 5,000 ppb action level, noncancer risks are projected to persist for 52 years (recreational intake) to 67 years (high intake), and cancer risks are projected persist for 92 years (recreational intake) to 100 years (high intake). For the No Action alternative, the only threshold that is met in less than 100 years is the threshold for the recreational consumption of walleye which is achieved in 92 years.

With the goals in mind of 10 years for safe fish consumption by recreational anglers and 30 years for safe fish consumption by high-intake consumers, only a remedial action level of 125 ppb results in meeting these goals in this reach.

**RAO 3 - Ecological Health.** As indicated in Table 8-16, the range of remedial action level projections results in thresholds being met within 1 year following remediation (e.g., piscivorous bird deformity and hatching success for all action levels, except for deformity NOAEC under no action) or thresholds not being met within 100 years (e.g., carnivorous bird, piscivorous mammal, and sediment invertebrate thresholds under the No Action alternative, and the sediment and piscivorous mammal thresholds under the 5,000 ppb action level). As compared to the 5,000 ppb action level, the 1,000, 500, 250, and 125 ppb action levels estimate a risk reduction to carnivorous birds of 71, 84, 89, and 95 percent, respectively. As compared to the 1,000 ppb action level, the 500, 250, and 125 ppb action levels result in a risk reduction to piscivorous mammals of 28, 42, and 65 percent, respectively, and a risk reduction to sediment invertebrates of 29, 39, and 65 percent, respectively. Attainment of the carnivorous bird threshold for the 125 ppb action level to the 5,000 ppb action level ranges from 4 to 76 years, respectively. Attainment of the piscivorous mammal threshold for the 125 ppb action level to the 1,000 ppb action level ranges from 15 to 43 years, respectively. Attainment of the sediment threshold for the 125 ppb action level to the 1,000 ppb action level ranges from 16 to 46 years, respectively.

With the goal in mind of 30 years for no adverse ecological risks, only a remedial action level of 250 ppb or less meets this goal. The 250 and 125 ppb action levels differ by approximately 45 percent in terms of the level of risk reduction achieved. Therefore, the action levels recommended that may be appropriate for this reach and this RAO are 250 and 125 ppb. The action levels of 5,000, 1,000, and 500 ppb should be dropped because they never result in the achievement of the stated goal.

**RAO 4 - Sediment Transport.** As presented in Table 8-18, 30 years following remediation the sediment PCB loading rates for the action levels as compared to the No Action alternative represent sediment PCB loading reductions of 55 percent (5,000 ppb), 93 percent (1,000 ppb), 96 percent (500 ppb), 97 percent (250 ppb), and 99 percent (125 ppb).

## Residual Mercury and DDE Levels

The distribution and concentrations of mercury and DDE and degree of co-location with PCBs within the Little Rapids to De Pere Reach are shown on Figure 8-5 (mercury and PCBs) and Figure 8-6 (DDE and PCBs). These figures indicate that mercury and DDE are predominantly co-located with PCBs.

The residual risk from mercury is about the same for the No Action alternative and the 5,000 ppb action level, although while concentrations of mercury may be as high as 10 mg/kg under both scenarios, the area of contamination is dramatically reduced with remedial action. Under either of these scenarios, mercury may be a risk to all ecological assessment endpoints evaluated except for piscivorous mammals and insectivorous birds (for which there were no data). Under the 1,000, 500, and 250 ppb remedial action levels, mercury levels are consistently between 1 and 5 mg/kg, which like the concentrations found in the Little Lake Butte des Morts Reach, may pose risk to invertebrates and piscivorous birds. At the 125 ppb action level, mercury concentrations of 0 to 1 mg/kg are found in the sediment, but these concentrations are not expected to result in any adverse risk.

Beginning with the 5,000 ppb remedial action level and remaining through the 125 ppb action level, DDE concentrations are between 1 and 25 $\mu$g/kg in the sediment and suggest no residual risk to ecological receptors.

## Conclusion

Based upon the evaluations presented above, the remedial action level of 125 ppb will meet the stated goals of the RAOs for this reach.

## 8.4.4 De Pere to Green Bay

### Residual PCB Levels

**RAO 1 - Surface Water Quality.** As presented in Table 8-5, the drinking water criteria of 0.003 ng/L is never met no matter what action level is selected. The wildlife criteria of 0.12 ng/L is not met within 100 years for either the no action or 5,000 ppb action level, yet it is met within 100 years for the other action levels: 69 years (1,000 ppb), 65 years (500 ppb), 40 years (250 ppb), and 27 years (125 ppb). As compared to the Lake Winnebago current maximum concentration of PCBs in surface water (13 ng/L), under the No Action alternative this concentration is not met within 100 years, under an action level of 5,000 ppb this concentration is met within 2 years, and for all of the other action levels this concentration is met immediately following remediation. Thirty years after remediation, surface water total PCB concentrations range from 0.09 ng/L (125 ppb) to 21.08 ng/L (no action).

**RAO 2 - Human Health.** As indicated in Table 8-14, the No Action alternative model output results in none of the thresholds being met within 100 years. As compared to the 5,000 ppb action level, the 1,000, 500, 250, and 125 ppb action level estimates result in a noncancer risk reduction of approximately 73, 81, 88, and 92 percent, respectively. As compared to the 5,000 ppb action level, the 1,000, 500, 250, and 125 ppb action levels result in a cancer risk reduction of approximately 48, 60, 76, and 83 percent, respectively.

For the 125 ppb remedial action level, noncancer risks are projected to persist for 7 years (recreational and high intake), and cancer risks are projected to persist for 15 years (recreational intake) to 20 years (high intake). For the 250 ppb action level, noncancer risks are projected to persist for 8 years (recreational intake) to 14 years (high intake), and cancer risks are projected to persist for 20 years (recreational intake) to 29 years (high intake). For the 500 ppb action level, noncancer risks are estimated to persist for 14 years (recreational intake) to 20 years (high intake), and cancer risks are estimated to persist for 34 years (recreational intake) to 45 years (high intake). For the 1,000 ppb action level, noncancer risks are projected to persist for 20 years (recreational intake) to 30 years (high intake) and cancer risks are projected to persist for 45 years (recreational intake) to 59 years (high intake). For the 5,000 ppb action level, modeled noncancer risks persist for 79 years (recreational intake) to 100 years (high intake), and modeled cancer risks persist for 100 years (recreational and high intake).

With the goals in mind of 10 years for safe fish consumption by recreational anglers, and 30 years for safe fish consumption by high-intake consumers following completion of an active remedy, none of the remedial action levels results in meeting these goals. The 250 and 125 ppb action levels come closest to achieving this goal, and differ by less than 10 percent in terms of the level of risk reduction achieved. Therefore, an action level of 250 ppb may be appropriate for this reach and this RAO.

**RAO 3 - Ecological Health.** As indicated in Table 8-16, the range of remedial action level projections results in thresholds being met within 1 year following remediation i.e., all piscivorous bird thresholds with the exception of the piscivorous bird NOAEC under the no action and 5,000 ppb action levels), or thresholds not being met within 100 years i.e., the carnivorous bird, piscivorous mammal, and sediment invertebrate thresholds under the No Action alternative). As compared to the 5,000 ppb action level, the 1,000, 500, 250, and 125 ppb action levels result in a risk reduction to carnivorous birds of 75, 82, 91, and 94 percent, respectively; a risk reduction to piscivorous mammals of 55, 66, 83, and 86 percent, respectively; and a risk reduction to sediment invertebrates of 60, 75, 86, and 94 percent, respectively. Excluding the No Action alternative, attainment of the carnivorous bird threshold ranges from 5 to 79 years, attainment of the piscivorous mammal threshold ranges from 14 to 100 years, and attainment of the sediment threshold ranges from 6 to 93 years for the 125 and 5,000 ppb action levels, respectively.

With the goal in mind of 30 years for no adverse ecological risks, only a remedial action level of 250 or 125 ppb results in meeting this goal. The 250 and 125 ppb action levels differ by approximately 33 percent in terms of the level of risk reduction achieved. Therefore, either action level may be appropriate for this reach and this RAO. The 5,000, 1,000, and 500 ppb action levels never result in the achievement of the stated goal.

**RAO 4 - Sediment Transport.** As presented in Table 8-18, 30 years following remediation the sediment PCB loading rates for the action levels as compared to the No Action alternative represent sediment PCB loading reductions of 86 percent (5,000 ppb), 98 percent (1,000 ppb), 99 percent (500 ppb), 99 percent (250 ppb), and 100 percent (125 ppb). Compared to the combined sediment PCB loading rate of the other tributaries to Green Bay (10 kg/yr), the No Action alternative results in not meeting this rate within 100 years, the 5,000 ppb action levels results in meeting this rate in 24 years, the 1,000 ppb action level results in meeting this rate in 4 years, the 500 and 250 ppb action levels result in meeting this rate in 1 year, and the 125 ppb action level meets this rate immediately following remediation.

### Residual Mercury and DDE Levels

The distribution and concentrations of mercury and DDE and degree of co-location with PCBs within the De Pere to Green Bay Reach are shown on Figure 8-7 (mercury and PCBs) and Figure 8-8 (DDE and PCBs). These figures clearly indicate that mercury and DDE are highly co-located with PCBs.

Under the 5,000, 1,000, and 500 ppb remedial action levels, mercury concentrations are consistently between 1 and 5 mg/kg, which like the concentrations found in the Little Lake Butte des Morts Reach, may pose risk to invertebrates and piscivorous birds. At the 250 and 125 ppb action levels, mercury concentrations of 0 to 1 mg/kg are found in the sediment, but these concentrations are not expected to result in any adverse risk.

DDE concentrations in sediment are found to be reduced with each level of remedial action. At the 5,000 ppb remedial action level, DDE concentrations of 25 to 100 $\mu$g/kg in the sediment may be present. At the 1,000 and 500 ppb action levels, these DDE concentrations are reduced to 1 to 25 $\mu$g/kg. At the 250 and 125 ppb action levels, DDE concentrations are less than 1 $\mu$g/kg. No action DDE concentrations in the sediment are 25 to 100 $\mu$g/kg and based on the risk assessment evaluation, these concentrations were found to pose risk to benthic invertebrates, benthic and pelagic fish, and piscivorous and carnivorous birds. Presumably, these risks decrease as the concentrations in the sediment decrease.

### Conclusion

Based upon the evaluations presented above, none of the remedial action levels meets all goals, but remedial action levels of 250 and 125 ppb will meet the stated goals of the ecological RAOs.

## 8.4.5 Green Bay Zone 2

### Residual PCB Levels

The remedial action levels considered for this zone included no action, 500, and 1,000 ppb.

**RAO 2 - Human Health.** As indicated in Table 8-15, none of the human health thresholds are met within 100 years no matter what remedial action level is used in the river or the bay.

**RAO 3 - Ecological Health.** As indicated in Table 8-17, the piscivorous bird LOAEC ecological thresholds are met in less than 1 year,[7] and the piscivorous bird deformity NOAEC and the carnivorous bird and piscivorous mammal thresholds are not met within 100 years no matter what remedial action level is used in the river or the bay. The only thresholds that are met within 100 years are the piscivorous bird NOAECs. Lower Fox River remedial action levels of 125 and 250 ppb did not affect the length of time required to meet the no observed deformity or hatching success thresholds for piscivorous birds in Green Bay; rather, the length of time was dependent only on the Green Bay action level. The deformity NOAEC threshold is met in the following number of years: 25 years (assuming a Green Bay action level of 500 ppb) and 28 years (assuming a Green Bay action level of 1,000 ppb). For the Lower Fox River remedial action level of 500 ppb, it takes 26 years (Green Bay action level of 500 ppb) and 29 years (Green Bay action level of 1,000 ppb), respectively. For the Lower Fox River remedial action level of 1,000 ppb, it takes 30 years (Green Bay action level of 1,000 ppb) to meet the deformity threshold. Assuming no action in Green Bay, the deformity NOAEC threshold is not met in less than 100 years. The piscivorous bird hatching success NOAEC was met in less than 1 year, except where the Green Bay action level was 1,000 ppb (1,000 ppb action level on the Lower Fox River) or where there was no action in Green Bay (for all Lower Fox River action levels).

## Residual Mercury and DDE Levels

The distribution and concentrations of mercury and DDE and degree of co-location with PCBs within the De Pere to Green Bay Reach are shown on Figure 8-9 (mercury and PCBs) and Figure 8-10 (DDE and PCBs). These figures indicate that mercury and DDE are highly co-located with PCBs, and that these compounds are widely dispersed in terms of area, but not in terms of frequency of occurrence. In the 11 samples that were analyzed, mercury was detected in 9 samples, and p,p'-DDD, p,p'-DDE, and p,p'-DDT were never detected (Table 8-4).

Under the no action remedial action level, mercury concentrations are consistently between non-detect and 5 mg/kg, which may pose risk to invertebrates and piscivorous birds. At the 1,000 and 500 ppb action levels, mercury concentrations of up to 1 mg/kg are found in the sediment, but these concentrations are not expected to result in any adverse risk.

[7] A projection of "1 year following remediation" is a model output, and should not necessarily be literally interpreted. See footnote 1 in Section 8.4.1, RAO 3 for a discussion.

## 8.4.6 Green Bay Zone 3A

### Residual PCB Levels

The remedial action levels considered for this zone included no action, 500, and 1,000 ppb.

**RAO 2 - Human Health.** As indicated in Table 8-15, none of the human health thresholds are met within 100 years no matter what remedial action level is used in the river or the bay.

**RAO 3 - Ecological Health.** As indicated in Table 8-17, all of the piscivorous bird ecological thresholds, except no observed piscivorous bird deformities, are met in less than 1 year, and the carnivorous bird and piscivorous mammal thresholds are not met within 100 years no matter what remedial action level is used in the river or the bay. Lower Fox River remedial action levels of 125, 250, 500, and 1,000 ppb did not affect the length of time required to meet the no observed piscivorous bird deformity threshold in Green Bay assuming Green Bay action levels of 500 and 1,000 ppb. Rather, the length of time was dependent only on the Green Bay action level. This threshold is met in the following number of years: 8 years (assuming a Green Bay action level of 500 ppb) and 11 years (assuming a Green Bay action level of 1,000 ppb). The number of years to reach this threshold assuming no action in Green Bay ranges from 43 years (with Lower Fox River action levels of 125, 250, 500, and 1,000 ppb), 44 years (with a Lower Fox River action level of 5,000 ppb), to 51 years (assuming no action on the river).

### Residual Mercury and DDE Levels

Assuming action levels of 500 and 1,000 ppb or no action in Green Bay Zone 3A, mercury is of potential risk to piscivorous birds and DDE is of no potential risk. These BLRA conclusions are based limited data: 2 sediment samples, 1 benthic fish, 12 pelagial fish, 3 carnivorous birds, and modeled concentrations in piscivorous and carnivorous birds, and piscivorous mammals. No data were available for insectivorous birds. As indicated on Figures 8-9 and 8-10 and in Table 8-4, of the two sediment samples analyzed, mercury and DDD/DDE/DDT were not detected.

## 8.4.7 Green Bay Zone 3B

### Residual PCB Levels

The remedial action levels considered for this zone included no action and 500 ppb.

**RAO 2 - Human Health.** As indicated in Table 8-15, the only human health threshold that is met in less than 100 years is the noncancer threshold for recreational anglers. This threshold is only met when Green Bay Zone 3B is remediated to an action level of 500 ppb and the Lower Fox River is remediated to either 125, 250, or 500 ppb. Under these different Lower Fox River action levels, it takes 99 years to reach the threshold.

**RAO 3 - Ecological Health.** As indicated in Table 8-17, all of the piscivorous bird ecological thresholds, except no observed piscivorous bird deformities, are met in less than 1 year, and the carnivorous bird and piscivorous mammal thresholds are not met within 100 years no matter what remedial action level is used in the river or the bay. Lower Fox River remedial action levels of 125, 250, 500, and 1,000 ppb did not affect the length of time required to meet the no observed piscivorous bird deformity threshold in Green Bay assuming a Green Bay action level of 500 ppb. Rather, the length of time was dependent only on the Green Bay action level. This threshold is met in 7 years assuming a Green Bay action level of 500 ppb (Lower Fox River action levels of 125, 250, and 500 ppb). The number of years to reach this threshold assuming no action in Green Bay ranges from 32 years (with as Lower Fox River action levels of 125, 250, 500, and 1,000 ppb), to 33 years (with a Lower Fox River action level of 5,000 ppb), to 38 years assuming no action on the river.

### Residual Mercury and DDE Levels

Assuming an action level of 500 ppb or no action in Green Bay Zone 3B, mercury is of risk to benthic invertebrates and potential risk to pelagial fish, and piscivorous and carnivorous birds. DDE is a potential risk for pelagic fish, and piscivorous and carnivorous birds. These BLRA conclusions are based on limited data: 4 sediment samples, 1 benthic fish, 4 pelagial fish, 20 piscivorous birds, and modeled concentrations in piscivorous and carnivorous birds, and piscivorous mammals. No data were available for insectivorous birds. As indicated on Figures 8-9 and 8-10 and in Table 8-4, of the four sediment samples analyzed, DDD/DDE/DDT were not detected, mercury was only detected in one of the samples, and the samples were not collected in areas of known PCB contamination.

## 8.4.8 Green Bay Zone 4

### Residual PCB Levels

No remedial action levels were considered for this zone. Only the No Action alternative was carried forward in the FS.

**RAO 2 - Human Health.** As indicated in Table 8-15, none of the human health thresholds are met within 100 years no matter what remedial action level is used in the river.

**RAO 3 - Ecological Health.** As indicated in Table 8-17, all of the piscivorous bird ecological thresholds are met in less than 1 year except for the deformity NOAEC, and the carnivorous bird and piscivorous mammal thresholds are not met within 100 years no matter what remedial action level is used in the river. The deformity NOAEC for piscivorous birds is met within 5 years at all Lower Fox River action levels.

### Residual Mercury and DDE Levels

Assuming no action in Green Bay Zone 4, mercury is of potential risk to piscivorous and carnivorous birds, and DDE is a potential risk for pelagic fish and carnivorous birds. These BLRA conclusions are based on limited data: 4 sediment samples, 20 pelagial fish, and modeled concentrations in piscivorous and carnivorous birds, and piscivorous mammals. No data were available for benthic fish or insectivorous birds. As indicated on Figures 8-9 and 8-10 and in Tables 8-3 and 8-4, of the four sediment samples analyzed, DDD/DDE/DDT were not detected, mercury was only detected in one of the samples, and PCB concentrations were less than 500 $\mu$g/kg.

### Conclusion

For all of Green Bay (zones 2, 3A, 3B, and 4), based upon the evaluations presented above, none of the action levels meet the state goals of the human health RAO. The only ecological RAO goals that are met within 100 years are the piscivorous bird hatching success NOAEC and LOAEC, and the piscivorous bird deformity LOAEC. Additionally, the piscivorous bird deformity NOAEC is met within 100 years in all zones except Zone 2.

## 8.5 Uncertainty Analysis

There is always considerable uncertainty in using a long-term predictive model to forecast risks to human health and the environment. While the wLFRM has been shown to be a reasonably accurate tool for forecasting changes to surface sediment concentrations and mass export of PCBs to Green Bay (WDNR, 1997), there remains uncertainty in the actual magnitude of the changes predicted by the model. These same uncertainties also apply to the GBTOXe model. These uncertainties reside in the models themselves, the assumptions used for each of the functional action levels, and the application of the actual data to the models. An assumption of the models that are used to project sediment loading rates and water, sediment, and tissue concentrations is that no matter what remedial action

level is selected, the remediation will take 10 years. A result of this assumption is that all of the model runs start and occur within the same hydrograph time frame. Therefore, water flow rates are consistent for each action level—high and low flow events occur at the same week for each action level. While this simplifies the comparison of residual PCB concentrations and load rates, it is understood that not all remedial action levels will take 10 years to implement. However, the uncertainties are mitigated by the fact that the alternative-specific risk assessment is intended solely to provide a relative level of residual risk between each of the proposed action levels, and not necessarily to provide 100 percent accurate predictions. Within this context, the models employed and the accompanying assumptions are adequate for the purposes of this FS.

Additional uncertainty results from the time between achieving an RAO human health or ecological threshold, and the time until risk reduction is actually observed. While total PCB concentrations in sediments may be at the selected action level concentration, it may take several years before fish show changes in total PCB body concentrations/mass. This uncertainty can be mitigated by a well-designed post-remediation sediment and fish tissue monitoring program (Appendix C).

Use of the wLFRM shows that over time most of the sediment is transported downstream, but this may still result in short-term increased risks to some organisms.

Finally, residual risks posed by the COCs other than total PCBs, are based upon the data in the FRDB. The distribution plots may be skewed by uneven, biased sampling for these other constituents.

## 8.6 Section 8 Figures and Tables

Figures and tables for Section 8 follow page 8-32 and include:

Figure 8-1 Surface Sediment Total PCB and Mercury Distribution: Little Lake Butte des Morts Reach

Figure 8-2 Surface Sediment Total PCB and DDE Distribution: Little Lake Butte des Morts Reach

Figure 8-3 Surface Sediment total PCB and Mercury Distribution: Appleton to Little Rapids Reach

Figure 8-4 Surface Sediment total PCB and DDE Distribution: Appleton to Little Rapids Reach

Figure 8-5 Surface Sediment Total PCB and Mercury Distribution: Little Rapids to De Pere Reach

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**No Action**

**5,000 ppb**

**1,000 ppb**

**500 ppb**

**250 ppb**

**125 ppb**

WISCONSIN

MENASHA

NEENAH

Lake Winnebago

PCB Concentrations (ug/kg)
- > 125
- > 250
- > 500
- > 1,000
- > 5,000
- Dredged Sediments

Mercury (mg/kg)
- 0 - 1
- 1 - 5
- 5 - 7
- 7 - 10

Roads

Water

Civil Divisions
- City
- Township
- Village

1 0 1 2 Miles

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Surface Sediment Total PCB and Mercury Distribution: Little Lake Butte des Morts Reach

FIGURE 8-1

FIGURE NO: FS8-1

CREATED BY: SCJ

PRINT DATE: 1/18/01

APPROVED: AGF

**No Action**

**5,000 ppb**

**1,000 ppb**

**500 ppb**

**250 ppb**

**125 ppb**

WISCONSIN

MENASHA

NEENAH

Lake Winnebago

PCB Concentrations (ug/kg)
- > 125
- > 250
- > 500
- > 1,000
- > 5,000
- Dredged Sediments

DDE (ug/kg)
- 1 - 25
- 25 - 100
- 500 - 1,000
- > 1,000

Roads

Water

Civil Divisions
- City
- Township
- Village

1 0 1 2 Miles

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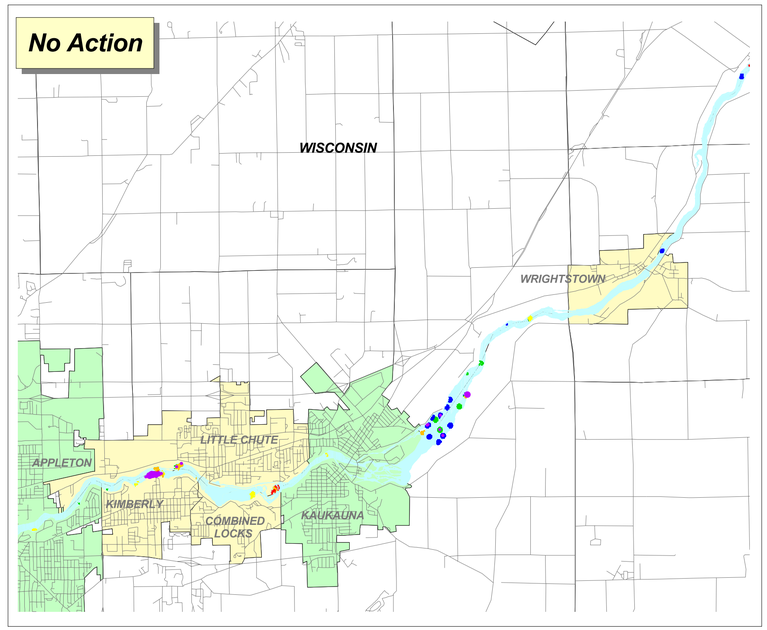
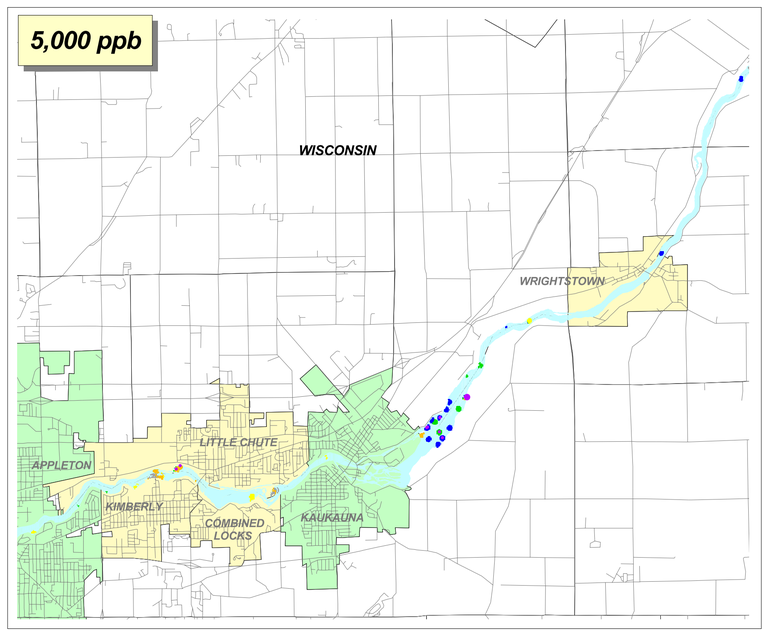
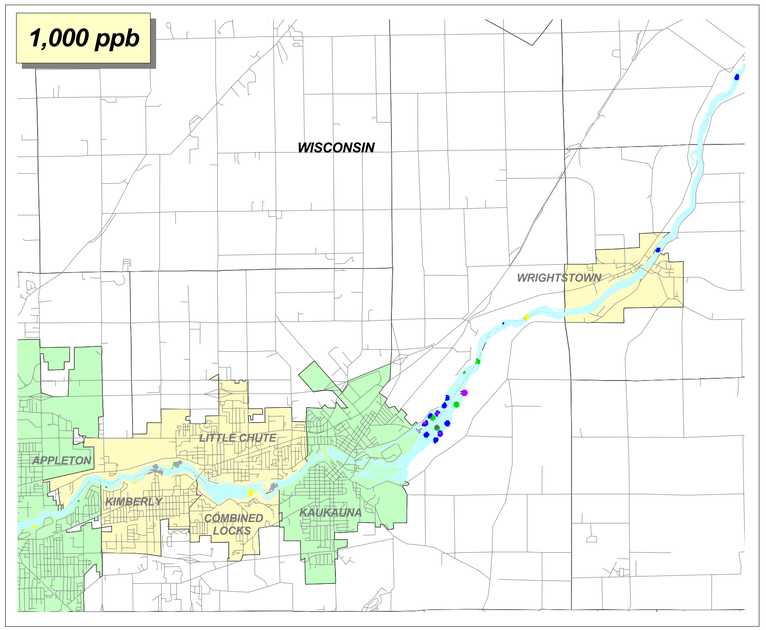
# Surface Sediment Total PCB and DDE Distribution: Little Lake Butte des Morts Reach

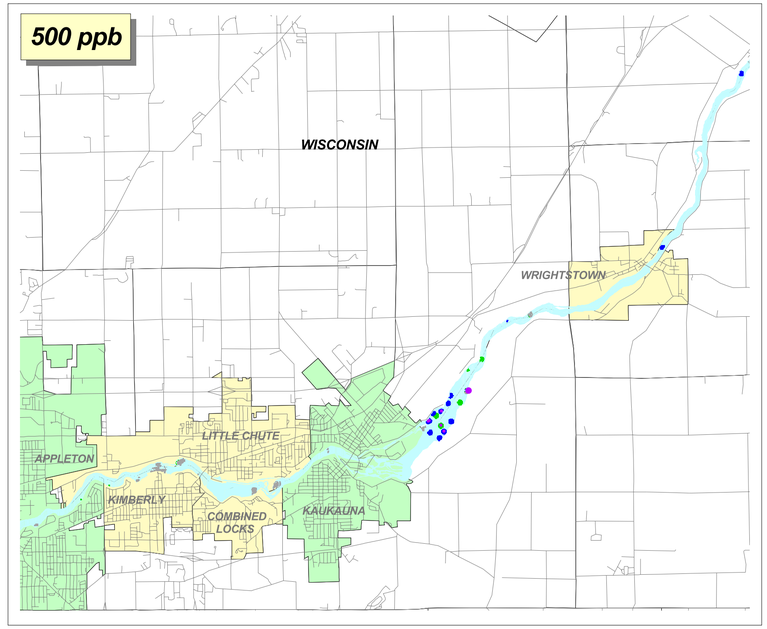
FIGURE 8-2

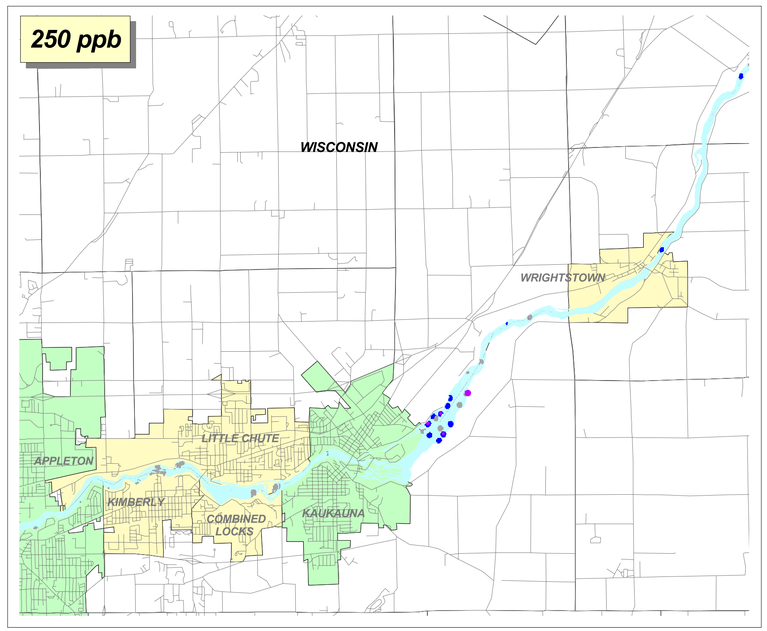
FIGURE NO: FS8-2
CREATED BY: SCJ
PRINT DATE: 1/18/01
APPROVED: AGF

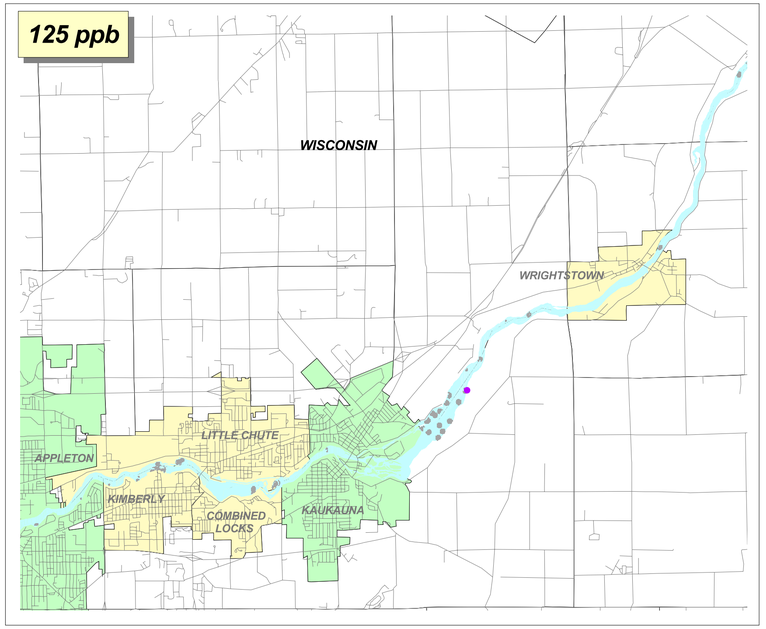



PCB Concentrations (ug/kg)
- > 125
- > 250
- > 500
- > 1,000
- > 5,000
- Dredged Sediments

Mercury (mg/kg)
- 0 - 1
- 1 - 5
- 5 - 7
- 7 - 10

Roads
Water

Civil Divisions
- City
- Township
- Village

N
W E
S

3 0 3 6 Miles

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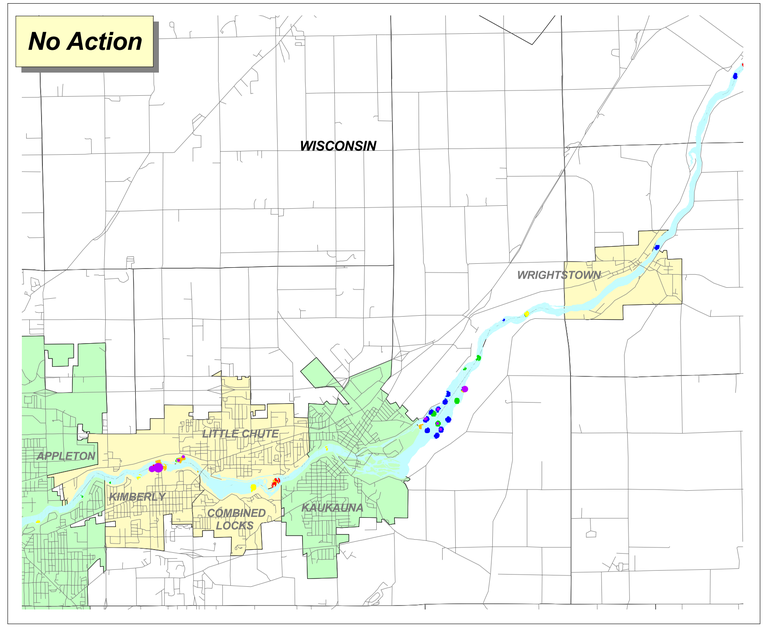
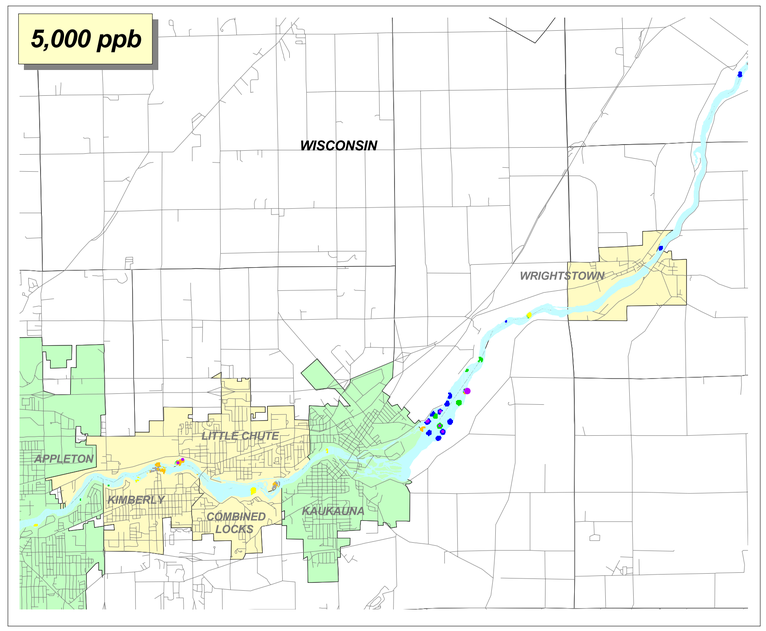
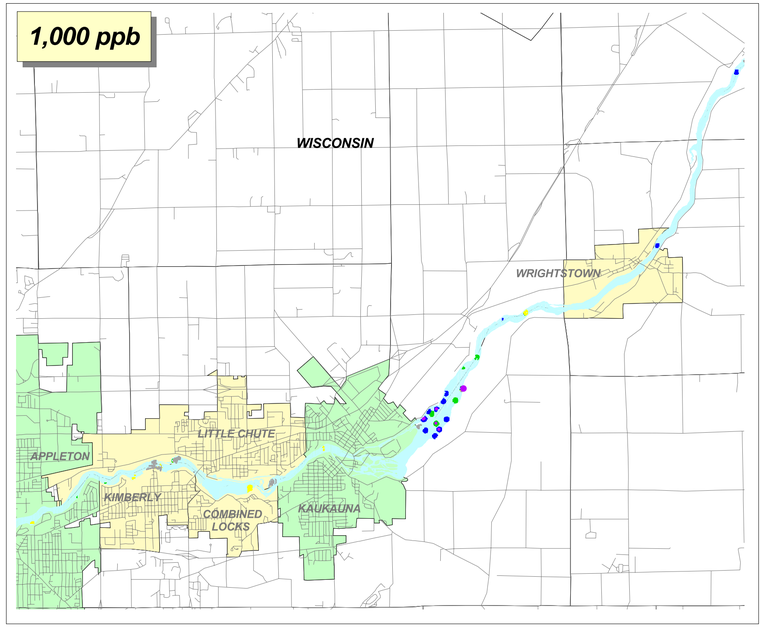
# Surface Sediment Total PCB and Mercury Distribution: Appleton to Little Rapids Reach

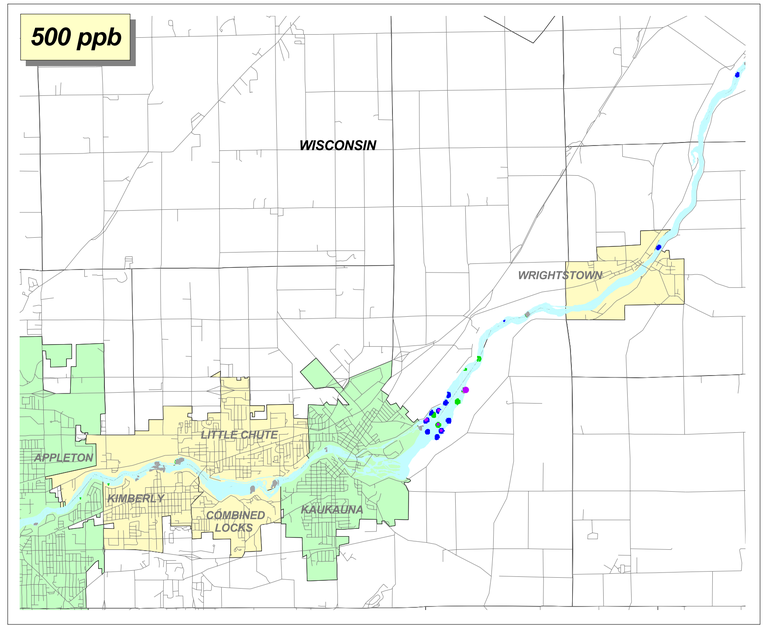
FIGURE 8-3

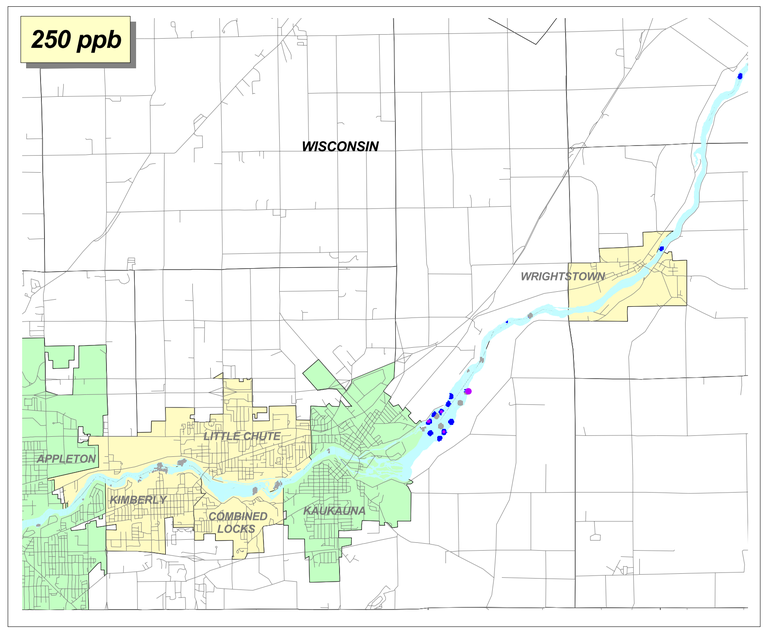
FIGURE NO: FS8-3
CREATED BY: SCJ
PRINT DATE: 1/18/01
APPROVED: AGF

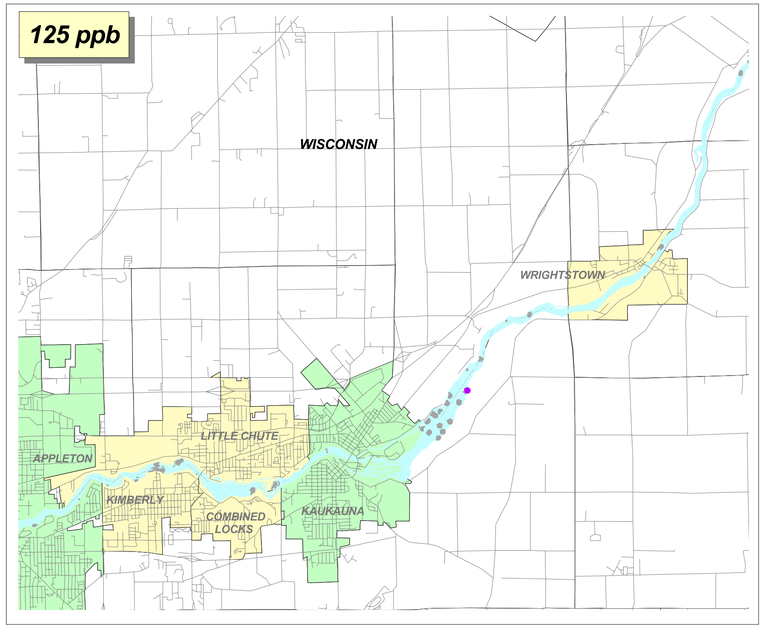



PCB Concentrations (ug/kg)
- > 125
- > 250
- > 500
- > 1,000
- > 5,000
- Dredged Sediments

DDE (ug/kg)
- 1 - 25
- 25 - 100
- 500 - 1,000
- > 1,000

- Roads
- Water

Civil Divisions
- City
- Township
- Village

N
W E
S

3 0 3 6 Miles

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Surface Sediment Total PCB and DDE Distribution: Appleton to Little Rapids Reach

FIGURE 8-4

| | |
|---|---|
| FIGURE NO: | FS8-4 |
| CREATED BY: | SCJ |
| PRINT DATE: | 1/18/01 |
| APPROVED: | AGF |

No Action

DE PERE

5,000 ppb

DE PERE

1,000 ppb

DE PERE

500 ppb

DE PERE

250 ppb

DE PERE

125 ppb

DE PERE

PCB Concentrations (ug/kg)
- > 125
- > 250
- > 500
- > 1,000
- > 5,000
- Dredged Sediments

Mercury (mg/kg)
- 0 - 1
- 1 - 5
- 5 - 7
- 7 - 10

Roads
Water

Civil Divisions
- City
- Township
- Village

1 0 1 2 Miles

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Surface Sediment Total PCB and Mercury Distribution: Little Rapids to De Pere Reach

FIGURE 8-5

FIGURE NO: FS8-5
CREATED BY: SCJ
PRINT DATE: 1/18/01
APPROVED: AGF

No Action

5,000 ppb

1,000 ppb

500 ppb

250 ppb

125 ppb

DE PERE

PCB Concentrations (ug/kg)
- > 125
- > 250
- > 500
- > 1,000
- > 5,000
- Dredged Sediments

DDE (ug/kg)
- 1 - 25
- 25 - 100
- 500 - 1,000
- > 1,000

Roads

Water

Civil Divisions
- City
- Township
- Village

N

W E

S

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# Surface Sediment Total PCB and DDE Distribution: Little Rapids to De Pere Reach

FIGURE 8-6

FIGURE NO: FS8-6
CREATED BY: SCJ
PRINT DATE: 1/18/01
APPROVED: AGF

**No Action**

**5,000 ppb**

**1,000 ppb**

**500 ppb**

**250 ppb**

**125 ppb**

HOWARD
GREEN BAY
ASHWAUBENON
DE PERE

PCB Concentrations (ug/kg)
- > 125
- > 250
- > 500
- > 1,000
- > 5,000
- Dredged Sediments

Mercury (mg/kg)
- 0 - 1
- 1 - 5
- 5 - 7
- 7 - 10

Roads
Water

Civil Divisions
- City
- Township
- Village

1 0 1 2 3 Miles

N
W E
S

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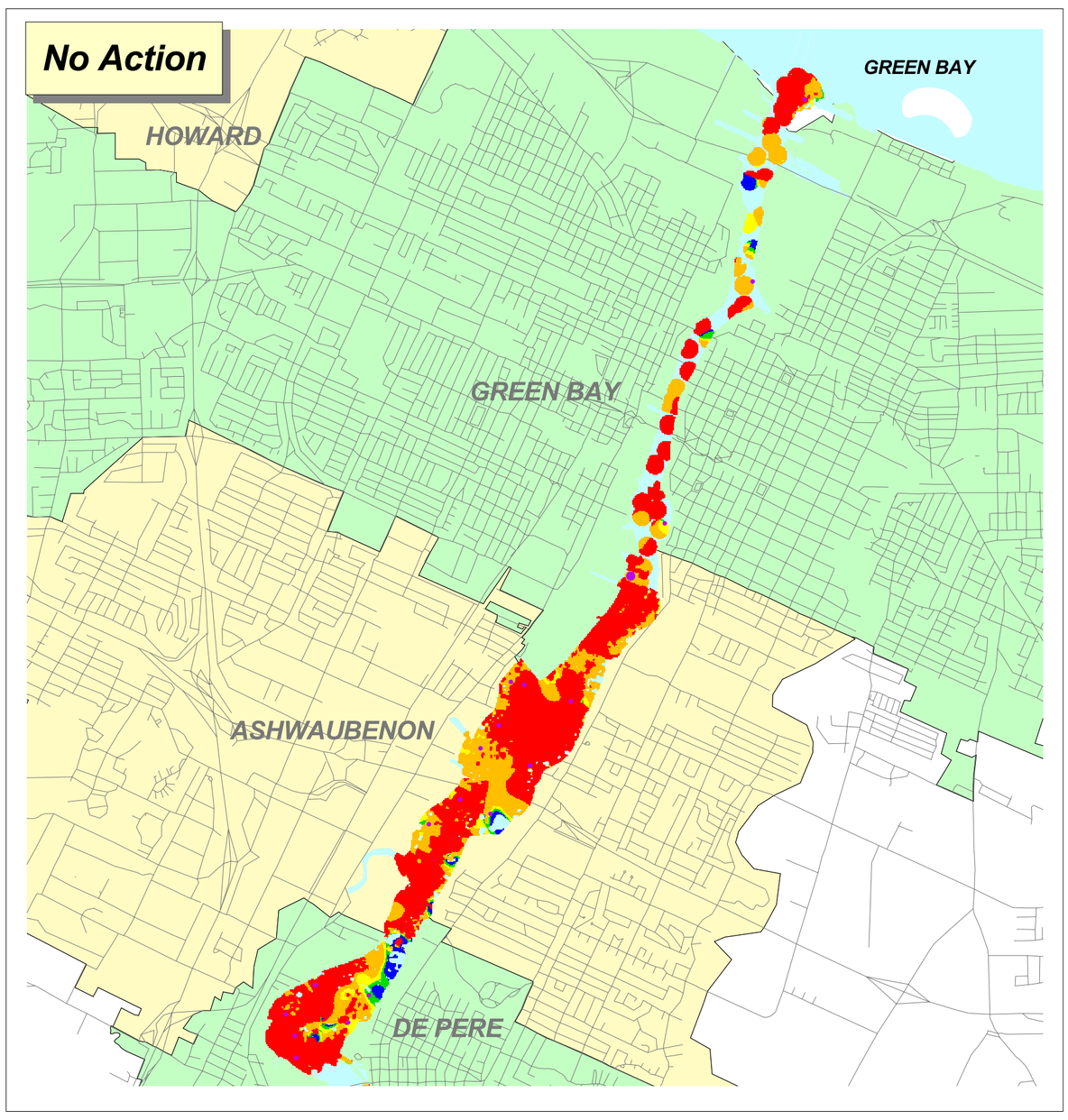
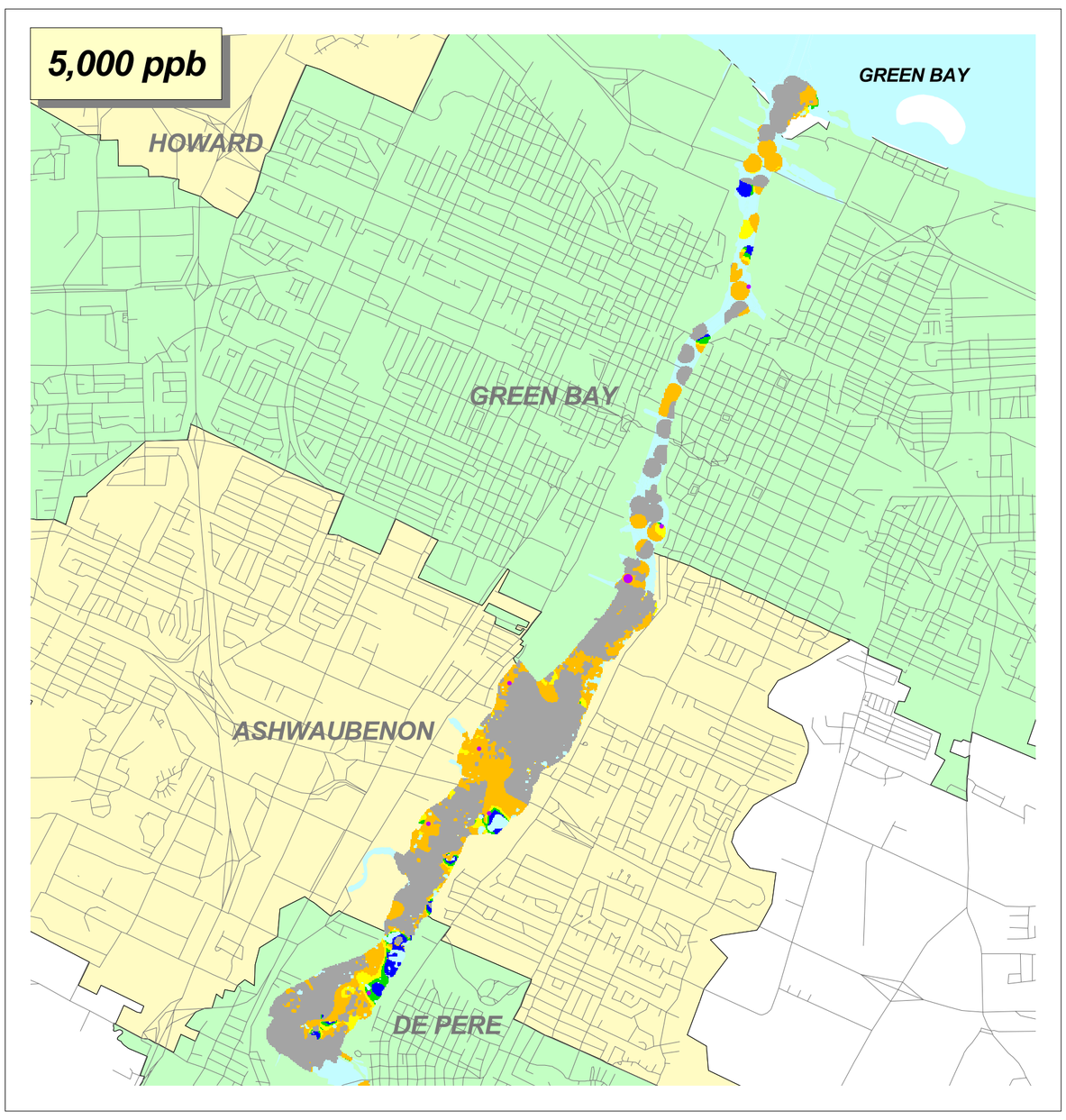
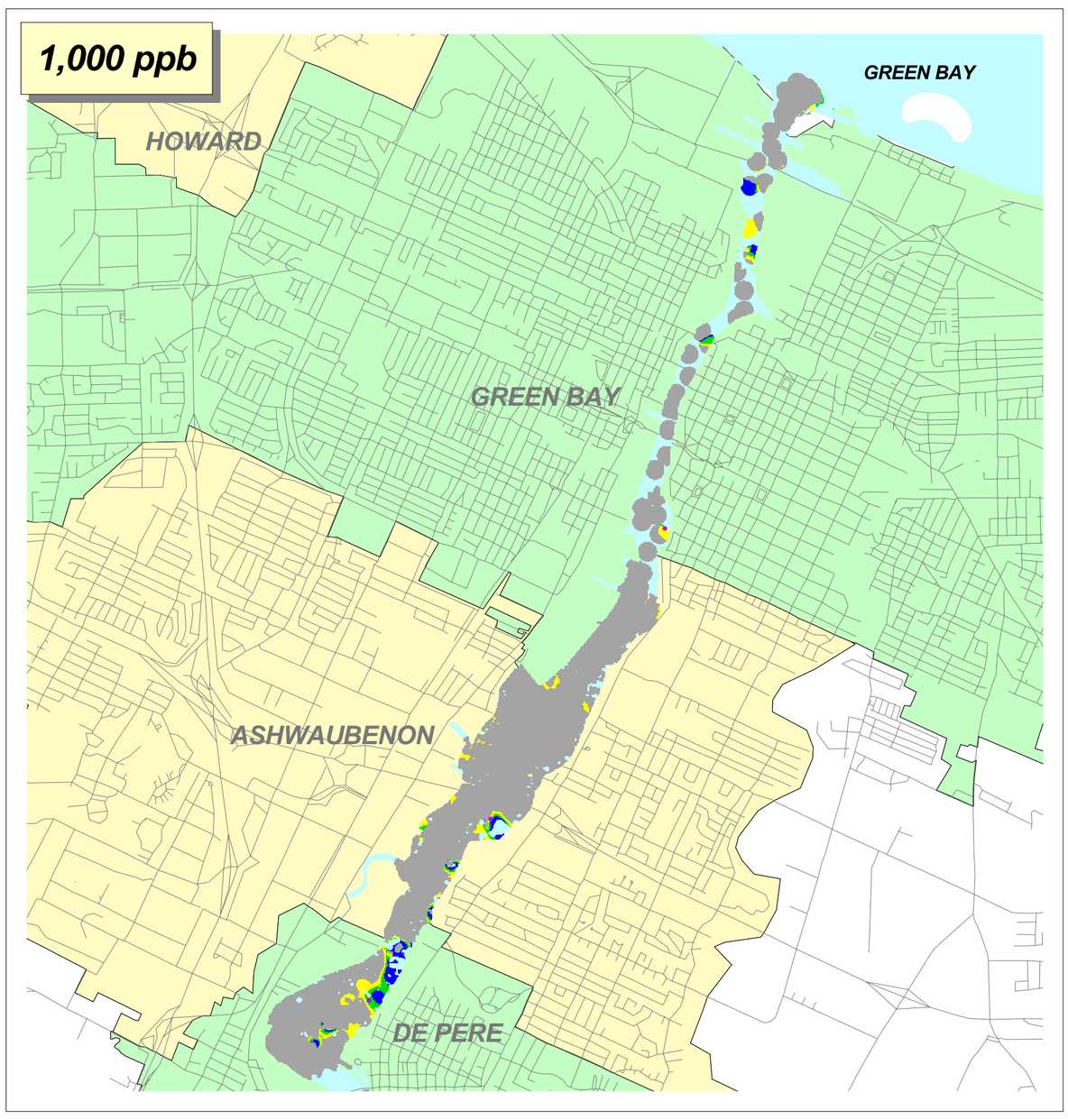
# Surface Sediment Total PCB and Mercury Distribution: De Pere to Green Bay Reach

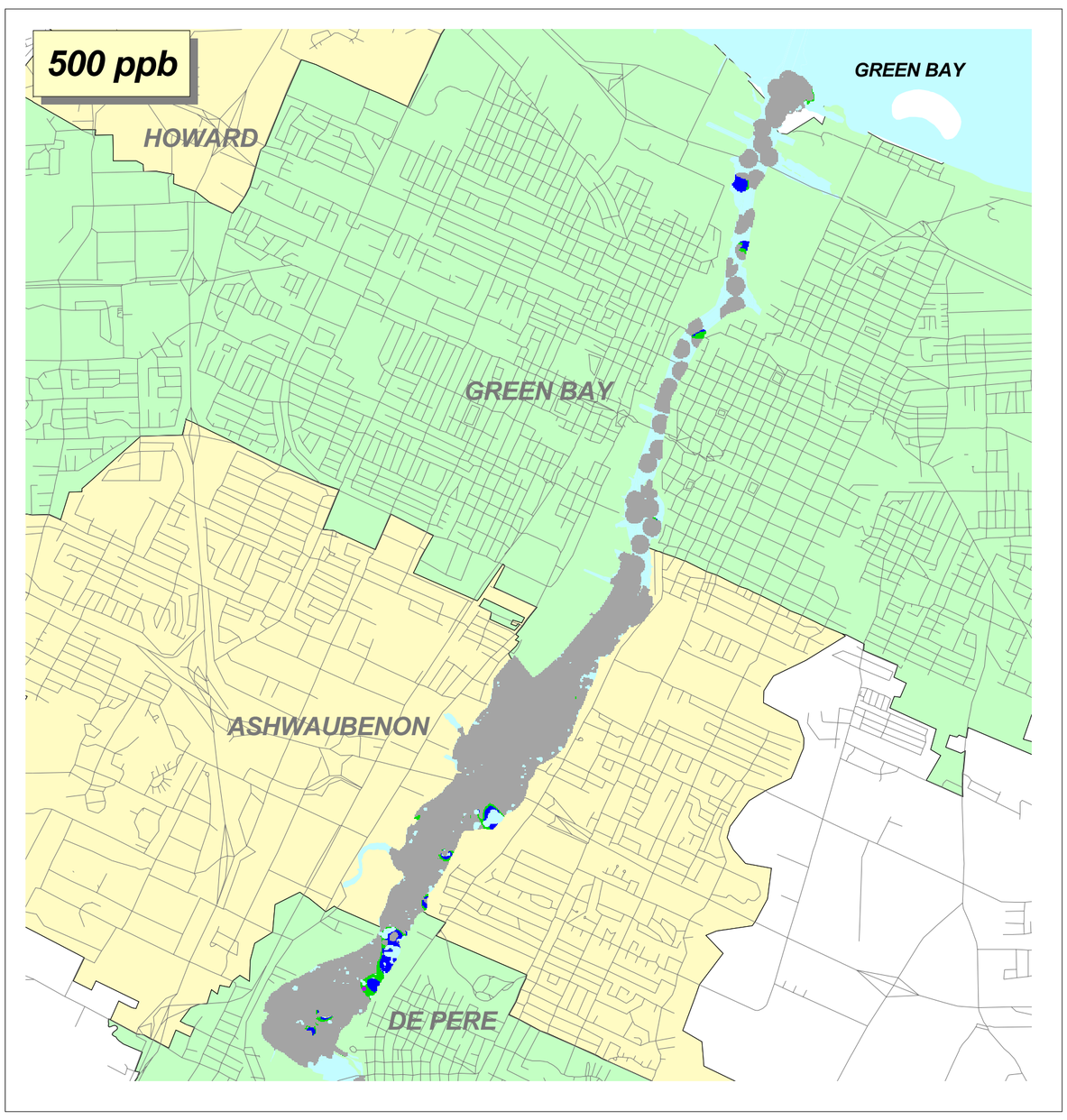
FIGURE 8-7

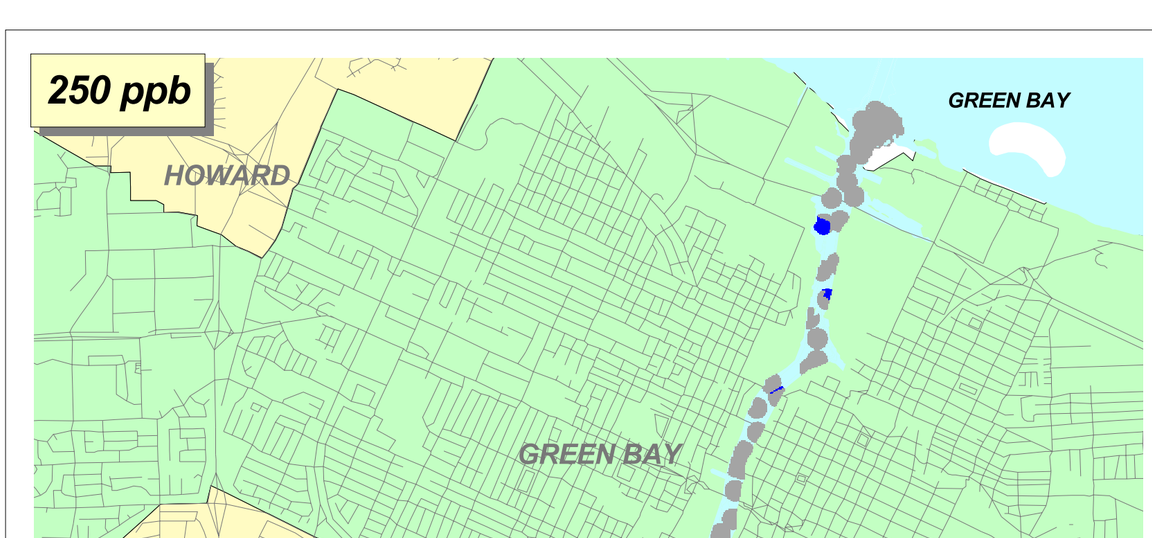
| | |
|---|---|
| FIGURE NO: | FS8-7 |
| CREATED BY: | SCJ |
| PRINT DATE: | 1/18/01 |
| APPROVED: | AGF |

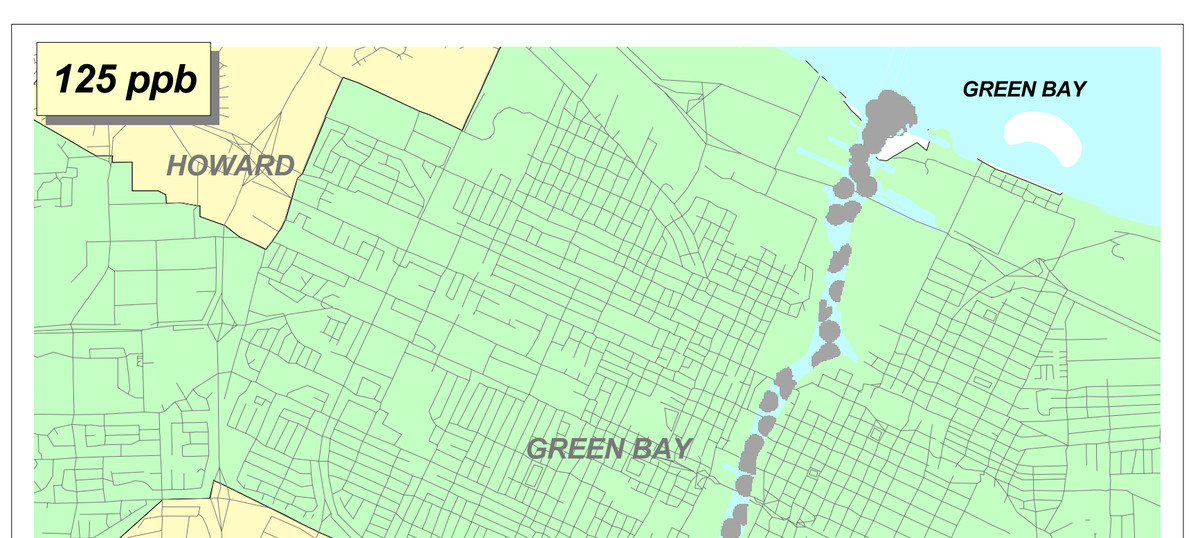



PCB Concentrations (ug/kg)
- > 125
- > 250
- > 500
- > 1,000
- > 5,000
- Dredged Sediments

DDE (ug/kg)
- 1 - 25
- 25 - 100
- 500 - 1,000
- > 1,000

Roads
Water

Civil Divisions
- City
- Township
- Village

N
W E
S

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# Surface Sediment Total PCB and DDE Distribution: De Pere to Green Bay Reach

FIGURE 8-8

FIGURE NO: FS8-8
CREATED BY: SCJ
PRINT DATE: 1/18/01
APPROVED: AGF

N
W
E
S

GLADSTONE
ESCANABA
GREEN BAY
ZONE 4
STEPHENSON
WAUSAUKEE
STEPHENSON
MENOMINEE
SISTER BAY
EPHRAIM
MARINETTE
POUND
PESHTIGO
EGG HARBOR
LENA
ZONE 3A
ZONE 3B
OCONTO FALLS
OCONTO
STURGEON BAY
LAKE MICHIGAN
FORESTVILLE
ZONE 2A
ALGOMA
HOWARD
ZONE 2B
CASCO
LUXEMBURG
GREEN BAY

PCB Concentrations (ug/kg)
> 500
> 1,000
> 5,000
Mercury (mg/kg)
0 - 1
1 - 5
5 - 7
7 - 10
Roads
Water
Civil Divisions
City
Township
Village

Project Area

2 0 2 4 6 Kilometers

2 0 2 4 Miles

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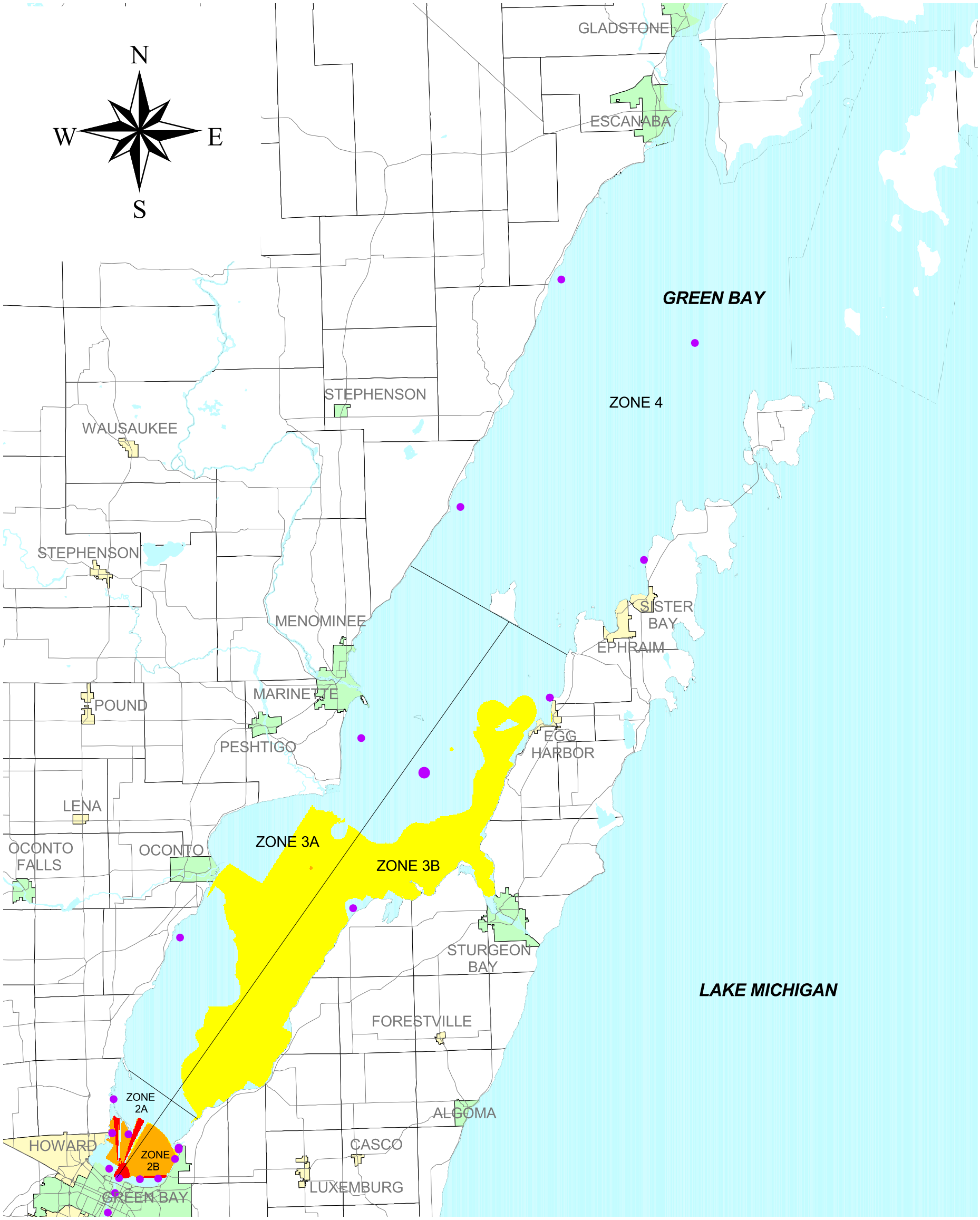
Green Bay Feasibility Study

**SURFACE SEDIMENT PCB AND MERCURY DISTRIBUTION IN GREEN BAY**

DATE: 05/03/01 | FILE: FS8GB | FIGURE 8-9

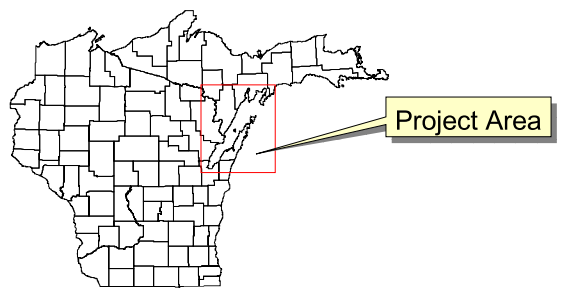



PCB Concentrations (ug/kg)
- > 500
- > 1,000
- > 5,000

DDE (ug/kg)
- 1 - 25
- 25 - 100
- 500 - 1,000
- > 1,000

Roads
Water

Civil Divisions
- City
- Township
- Village




2 0 2 4 6 Kilometers

2 0 2 4 Miles

ThermoRetec

| | | | |
|---|---|---|---|
| Lower Fox River & Green Bay Feasibility Study | | | **SURFACE SEDIMENT PCB AND DDE DISTRIBUTION IN GREEN BAY** |
| DATE: 05/03/01 | | FILE: FS8GB | FIGURE 8-10 |

## Table 8-1 Relationship of Models Used for Risk Projections in the Lower Fox River or Green Bay

| | BASELINE AND REMEDIAL CONDITIONS | FATE AND TRANSPORT MODELS | BIOACCUMULATION MODELS |
|---|---|---|---|
| ***MODEL*** | SEDIMENT BED MAPS | WHOLE LOWER FOX RIVER MODEL<br>Little Lake Butte des Morts to River Mouth<br><br>ENHANCED GREEN BAY TOXICS MODEL<br>Zone 2 through Zone 4 | FOX RIVER FOOD<br>Little Lake Butte des Morts to River Mouth<br><br>GREEN BAY FOOD<br>Zone 2 through Zone 4 |
| ***OUTPUT*** | • Baseline and Remedial Action Level Surface Sediment Concentrations<br>• Surface-weighted Average Concentrations<br>• Residual DDE and Mercury Risks (RAO 2 & 3) | • Total PCBs in Water (RAO 1)<br>• Total PCBs in Sediments (RAO 3)<br>• Downstream PCB Transport (RAO 4) | • Total PCBs in Forage Fish (RAO 3) Alewife, shiners, shad<br>• Total PCBs in Benthic Fish (RAO 2 & 3) Carp<br>• Total PCBs in Piscivorous Fish (RAO 2 & 3) Walleye, perch |
| ***DOCUMENTATION*** | *Remedial Investigation*<br>*Technical Memorandum 2e*<br>*Technical Memorandum 2e Addendum*<br>*Technical Memorandum 2f* | *Model Documentation Technical Memo*<br>*wLFRM Model Documentation Report (Appendix B)*<br>*GBTOXe Model Documentation Report (Appendix C)* | *Baseline Risk Assessment*<br>*FRFood Model Documentation Report (Appendix D)*<br>*GBFood Model Documentation Report (Appendix E)* |
| ***APPLICATION*** | *Remedial Investigation*<br>*Baseline Risk Assessment*<br>*Feasibility Study* | *Baseline Risk Assessment*<br>*Feasibility Study* | *Baseline Risk Assessment*<br>*Feasibility Study* |

## Table 8-2 Whole Body Fish Tissue Concentrations Estimated for Human Health Effects at a $10^{-5}$ Cancer Risk and a Hazard Index of 1.0

| | Fish Parameters | Whole Fish Tissue Concentrations | | | |
|---|---|---|---|---|---|
| | Fillet-to-whole Fish Ratio | Recreational Anglers: Avgerage of Michigan Studies (West *et al.*, 1989; West *et al.*, 1993) | | High-intake Fish Consumers: Average of Low-income Minority Anglers and Hmong Anglers (West *et al.*, 1993; Hutchison and Kraft, 1994) | |
| | | RME µg/kg | CTE µg/kg | RME µg/kg | CTE µg/kg |
| ***Risk-based Fillet Fish Concentrations (µg/kg) for Risk of $10^{-5}$ **** | | 18 | 120 | 12 | 63 |
| *Whole Fish Thresholds for Risk of $10^{-5}$* | | | | | |
| Carp | 0.53 | ***34*** | ***226*** | ***23*** | ***119*** |
| Walleye | 0.17 | ***106*** | ***706*** | ***71*** | ***371*** |
| Yellow Perch | 0.17 | ***106*** | ***706*** | ***71*** | ***371*** |
| ***Risk-based Fillet Fish Concentrations (µg/kg) for HI of 1.0*** | | 49 | 200 | 31 | 101 |
| *Whole Fish Thresholds for HI of 1.0* | | | | | |
| Carp | 0.53 | ***92*** | ***377*** | ***58*** | ***191*** |
| Walleye | 0.17 | ***288*** | ***1,176*** | ***181*** | ***594*** |
| Yellow Perch | 0.17 | ***288*** | ***1,176*** | ***181*** | ***594*** |

**Notes:**

* ***Whole fish thresholds for cancer risks of $10^{-4}$ and $10^{-6}$ are an order of magnitude higher, and lower, respectively.***

RME indicates reasonable maximum exposure and CTE indicates central tendency exposure.

Whole fish thresholds are **bolded** and in *italics*.

## Table 8-3 No Action Non-interpolated Sediment Concentrations of Total PCBs (µg/kg)

| Reach or Zone | Number of Samples | Number of Detects | Mean | 95% UCL |
|---|---|---|---|---|
| Little Lake Butte des Morts | 302 | 294 | 10,724 | 22,848 |
| Appleton to Little Rapids | 131 | 122 | 6,751 | 15,267 |
| Little Rapids to De Pere | 209 | 203 | 4,782 | 10,543 |
| De Pere to Green Bay (Green Bay Zone 1) | 290 | 285 | 4,184 | 5,510 |
| Green Bay Zone 2 | 15 | 14 | 251 | 720 |
| Green Bay Zone 3A | 15 | 13 | 376 | 518 |
| Green Bay Zone 3B | 40 | 35 | 542 | 809 |
| Green Bay Zone 4 | 31 | 27 | 83 | 117 |

## Table 8-4 No Action Sediment Concentrations of Mercury and DDT/DDD/DDE

| Reach or Zone | Analyte | Units | Number of Samples | Number of Detects | Mean | 95% UCL | |
|---|---|---|---|---|---|---|---|
| Little Lake Butte des Morts | Mercury | mg/kg | 86 | 71 | 1.0 | 1.4 | |
| | p,p'-DDD | µg/kg | 23 | 4 | 17.8 | 19 | * |
| | p,p'-DDE | µg/kg | 20 | 0 | | | |
| | p,p'-DDT | µg/kg | 20 | 2 | 13.0 | 50.0 | ** |
| Appleton to Little Rapids | Mercury | mg/kg | 10 | 10 | 0.8 | 1.7 | |
| | p,p'-DDD | µg/kg | 10 | 2 | 1.0 | 1.7 | ** |
| | p,p'-DDE | µg/kg | 10 | 0 | | | |
| | p,p'-DDT | µg/kg | 10 | 1 | | 3.4 | *** |
| Little Rapids to De Pere | Mercury | mg/kg | 74 | 74 | 3.5 | 4.0 | |
| | p,p'-DDD | µg/kg | 20 | 5 | 1.5 | 2.8 | ** |
| | p,p'-DDE | µg/kg | 19 | 4 | 12.5 | 22.0 | * |
| | p,p'-DDT | µg/kg | 14 | 3 | 16.5 | 20.0 | * |
| De Pere to Green Bay (Green Bay Zone 1) | Mercury | mg/kg | 92 | 89 | 1.0 | 1.4 | |
| | p,p'-DDD | µg/kg | 22 | 3 | 1.2 | 4.5 | ** |
| | p,p'-DDE | µg/kg | 22 | 1 | | 1.9 | *** |
| | p,p'-DDT | µg/kg | 22 | 0 | | | |
| Green Bay Zone 2 | Mercury | mg/kg | 11 | 9 | 0.5 | 1.5 | * |
| | p,p'-DDD | µg/kg | 11 | 0 | | | |
| | p,p'-DDE | µg/kg | 11 | 0 | | | |
| | p,p'-DDT | µg/kg | 11 | 0 | | | |
| Green Bay Zone 3A | Mercury | mg/kg | 2 | 0 | | | |
| | p,p'-DDD | µg/kg | 2 | 0 | | | |
| | p,p'-DDE | µg/kg | 2 | 0 | | | |
| | p,p'-DDT | µg/kg | 2 | 0 | | | |
| Green Bay Zone 3B | Mercury | mg/kg | 4 | 1 | | 0.2 | *** |
| | p,p'-DDD | µg/kg | 4 | 0 | | | |
| | p,p'-DDE | µg/kg | 4 | 0 | | | |
| | p,p'-DDT | µg/kg | 4 | 0 | | | |
| Green Bay Zone 4 | Mercury | mg/kg | 4 | 1 | | 0.11 | *** |
| | p,p'-DDD | µg/kg | 4 | 0 | | | |
| | p,p'-DDE | µg/kg | 4 | 0 | | | |
| | p,p'-DDT | µg/kg | 4 | 0 | | | |

**Notes:**

* Maximum concentration not the 95% UCL.

** Minimum and maximum concentration.

*** Only concentration.

# Table 8-5 Projected Surface Water Concentrations - RAO 1

**A. RAO 1: Years to Reach Comparative Surface Water Concentrations**

| River Reach | Comparative Surface Water Total PCB Concentrations (ng/L)[1] | Action Level (ppb) | | | | | |
|---|---|---|---|---|---|---|---|
| | | No Action | 5,000 | 1,000 | 500 | 250 | 125 |
| Little Lake Butte des Morts | drinking water criteria (0.003 ng/L) | >100 | >100 | >100 | >100 | >100 | >100 |
| | wildlife criteria (0.12 ng/L) | >100 | >100 | 52 | 39 | 19 | 16 |
| | Lake Winnebago maximum concentration (13 ng/L) | 4 | 1 | <1 | <1 | <1 | <1 |
| Appleton to Little Rapids | drinking water criteria (0.003 ng/L) | >100 | >100 | >100 | >100 | >100 | >100 |
| | wildlife criteria (0.12 ng/L) | >100 | >100 | 52 | 40 | 21 | 19 |
| | Lake Winnebago maximum concentration (13 ng/L) | 4 | <1 | <1 | <1 | <1 | <1 |
| Little Rapids to De Pere | drinking water criteria (0.003 ng/L) | >100 | >100 | >100 | >100 | >100 | >100 |
| | wildlife criteria (0.12 ng/L) | >100 | >100 | 65 | 54 | 40 | 27 |
| | Lake Winnebago maximum concentration (13 ng/L) | 9 | 2 | <1 | <1 | <1 | <1 |
| De Pere to Green Bay | drinking water criteria (0.003 ng/L) | >100 | >100 | >100 | >100 | >100 | >100 |
| | wildlife criteria (0.12 ng/L) | >100 | >100 | 69 | 65 | 40 | 27 |
| | Lake Winnebago maximum concentration (13 ng/L) | >100 | 2 | <1 | <1 | <1 | <1 |

**Note:**
[1] Wildlife criteria comes from NR 105 WAC and the Lake Winnebago concentration is the current concentration.

**B. RAO 1: Surface Water Total PCB Concentrations - 30 Years Post-remediation (ng/L)[1]**

| River Reach | Action Level (ppb) | | | | | |
|---|---|---|---|---|---|---|
| | No Action | 5,000 | 1,000 | 500 | 250 | 125 |
| Little Lake Butte des Morts | 2.99 | 1.67 | 0.18 | 0.13 | 0.05 | 0.04 |
| Appleton to Little Rapids | 2.76 | 1.59 | 0.19 | 0.14 | 0.06 | 0.04 |
| Little Rapids to De Pere | 5.37 | 2.36 | 0.37 | 0.24 | 0.14 | 0.08 |
| De Pere to Green Bay | 21.08 | 2.60 | 0.42 | 0.28 | 0.15 | 0.09 |

**Note:**
[1] 30 years post-remediation for all action levels.

# Table 8-6 Remedial Action Levels and Attainment of Human Health and Ecological Thresholds (Years until Thresholds Are Met): Little Lake Butte des Morts Reach

| Media Threshold Concentration (µg/kg) [1] | Media [2] | Threshold Type | Risk Level | Receptor | Remedial Action Level (ppb) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | No Action | 5,000 | 1,000 | 500 | 250 | 125 |
| 7,060 | walleye | human health | CTE $10^{-4}$ cancer risk level | recreational angler | <1 | <1 | <1 | <1 | <1 | <1 |
| 3,710 | walleye | human health | CTE $10^{-4}$ cancer risk level | high-intake fish consumer | <1 | <1 | <1 | <1 | <1 | <1 |
| 2,260 | carp | human health | CTE $10^{-4}$ cancer risk level | recreational angler | 8 | <1 | <1 | <1 | <1 | <1 |
| 1,190 | carp | human health | CTE $10^{-4}$ cancer risk level | high-intake fish consumer | 20 | 8 | <1 | <1 | <1 | <1 |
| 1,176 | walleye | human health | CTE hazard index of 1.0 | recreational angler | 14 | 2 | <1 | <1 | <1 | <1 |
| 1,060 | walleye | human health | RME $10^{-4}$ cancer risk level | recreational angler | 14 | 4 | <1 | <1 | <1 | <1 |
| 710 | walleye | human health | RME $10^{-4}$ cancer risk level | high-intake fish consumer | 20 | 9 | <1 | <1 | <1 | <1 |
| 706 | walleye | human health | CTE $10^{-5}$ cancer risk level | recreational angler | 20 | 9 | <1 | <1 | <1 | <1 |
| 588 | walleye | human health | CTE hazard index of 1.0 | high-intake fish consumer | 29 | 11 | <1 | <1 | <1 | <1 |
| 377 | carp | human health | CTE hazard index of 1.0 | recreational angler | 55 | 34 | <1 | <1 | <1 | <1 |
| 371 | walleye | human health | CTE $10^{-5}$ cancer risk level | high-intake fish consumer | 40 | 17 | <1 | <1 | <1 | <1 |
| 340 | carp | human health | RME $10^{-4}$ cancer risk level | recreational angler | 58 | 35 | 2 | <1 | <1 | <1 |
| 288 | walleye | human health | RME hazard index of 1.0 | recreational angler | 51 | 29 | <1 | <1 | <1 | <1 |
| 230 | carp | human health | RME $10^{-4}$ cancer risk level | high-intake fish consumer | 70 | 46 | 5 | 2 | <1 | <1 |
| 226 | carp | human health | CTE $10^{-5}$ cancer risk level | recreational angler | 71 | 46 | 5 | 2 | <1 | <1 |
| 189 | carp | human health | CTE hazard index of 1.0 | high-intake fish consumer | 77 | 54 | 8 | 4 | <1 | <1 |
| 181 | walleye | human health | RME hazard index of 1.0 | high-intake fish consumer | 65 | 40 | 4 | <1 | <1 | <1 |
| 119 | carp | human health | CTE $10^{-5}$ cancer risk level | high-intake fish consumer | 100 | 67 | 14 | 10 | 2 | <1 |
| 106 | walleye | human health | RME $10^{-5}$ cancer risk level | recreational angler | 84 | 57 | 9 | 5 | <1 | <1 |
| 92 | carp | human health | CTE hazard index of 1.0 | recreational angler | >100 | 77 | 17 | 14 | 4 | 2 |
| 71 | walleye | human health | RME $10^{-5}$ cancer risk level; CTE $10^{-6}$ cancer risk level | high-intake fish consumer; recreational angler | 100 | 70 | 14 | 10 | 4 | 2 |
| 58 | carp | human health | RME hazard index of 1.0 | high-intake fish consumer | >100 | 95 | 25 | 21 | 8 | 5 |
| 37 | walleye | human health | CTE $10^{-6}$ cancer risk level | high-intake fish consumer | >100 | 95 | 25 | 20 | 9 | 7 |
| 34 | carp | human health | RME $10^{-5}$ cancer risk level | recreational angler | >100 | >100 | 37 | 33 | 15 | 11 |
| 23 | carp | human health | RME $10^{-5}$ cancer risk level; CTE $10^{-6}$ cancer risk level | high-intake fish consumer; recreational angler | >100 | >100 | 51 | 42 | 20 | 17 |
| 12 | carp | human health | CTE $10^{-6}$ cancer risk level | high-intake fish consumer | >100 | >100 | 70 | 61 | 34 | 30 |
| 11 | walleye | human health | RME $10^{-6}$ cancer risk level | recreational angler | >100 | >100 | 58 | 50 | 25 | 20 |
| 7 | walleye | human health | RME $10^{-6}$ cancer risk level | high-intake fish consumer | >100 | >100 | 70 | 64 | 34 | 30 |
| 3 | carp | human health | RME $10^{-6}$ cancer risk level | recreational angler | >100 | >100 | >100 | >100 | >100 | >100 |
| 2 | carp | human health | RME $10^{-6}$ cancer risk level | high-intake fish consumer | >100 | >100 | >100 | >100 | >100 | >100 |
| 7,600 | walleye | ecological | LOAEC | fish | <1 | <1 | <1 | <1 | <1 | <1 |
| 7,600 | carp | ecological | LOAEC | fish | <1 | <1 | <1 | <1 | <1 | <1 |
| 4,083 | gizzard shad | ecological | LOAEC | piscivorous bird deformity | <1 | <1 | <1 | <1 | <1 | <1 |
| 3,879 | gizzard shad | ecological | LOAEC | piscivorous bird hatching success | <1 | <1 | <1 | <1 | <1 | <1 |
| 2,399 | gizzard shad | ecological | NOAEC | piscivorous bird hatching success | <1 | <1 | <1 | <1 | <1 | <1 |
| 1,207 | carp | ecological | LOAEC | carnivorous bird deformity | 18 | 8 | <1 | <1 | <1 | <1 |
| 1,147 | carp | ecological | LOAEC | carnivorous bird hatching success | 17 | 8 | <1 | <1 | <1 | <1 |
| 760 | walleye | ecological | NOAEC | fish | 20 | 8 | <1 | <1 | <1 | <1 |
| 760 | carp | ecological | NOAEC | fish | 32 | 14 | <1 | <1 | <1 | <1 |
| 709 | carp | ecological | NOAEC | carnivorous bird hatching success | 34 | 15 | <1 | <1 | <1 | <1 |
| 500 | carp | ecological | LOAEC | piscivorous mammal | 42 | 22 | <1 | <1 | <1 | <1 |
| 408 | gizzard shad | ecological | NOAEC | piscivorous bird deformity | <1 | <1 | <1 | <1 | <1 | <1 |
| 121 | carp | ecological | NOAEC | carnivorous bird deformity | 100 | 67 | 14 | 9 | < 1 | < 1 |
| 50 | carp | ecological | NOAEC | piscivorous mammal | >100 | 100 | 29 | 25 | 9 | 7 |
| 223 | sediment | ecological | TEL | sediment invertebrate | >100 | >100 | 60 | 52 | 26 | 21 |

**Notes:**

[1] Sediment concentration is presented in units of mg/kg OC.

[2] Fish concentrations are whole body.

CTE - Central Tendency Exposure

LOAEC - Lowest Observed Adverse Effect Concentration

NOAEC - No Observed Adverse Effect Concentration

RME - Reasonable Maximum Exposure

TEL - Threshold Effect Level

# Table 8-7 Remedial Action Levels and Attainment of Human Health and Ecological Thresholds (Years until Thresholds Are Met): Appleton to Little Rapids Reach

| Media Threshold Concentration (µg/kg) [1] | Media [2] | Threshold Type | Risk Level | Receptor | Remedial Action Level (ppb) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | No Action | 5,000 | 1,000 | 500 | 250 | 125 |
| 7,060 | walleye | human health | CTE $10^{-4}$ cancer risk level | recreational angler | <1 | <1 | <1 | <1 | <1 | <1 |
| 3,710 | walleye | human health | CTE $10^{-4}$ cancer risk level | high-intake fish consumer | <1 | <1 | <1 | <1 | <1 | <1 |
| 2,260 | carp | human health | CTE $10^{-4}$ cancer risk level | recreational angler | 2 | <1 | <1 | <1 | <1 | <1 |
| 1,190 | carp | human health | CTE $10^{-4}$ cancer risk level | high-intake fish consumer | 12 | 5 | <1 | <1 | <1 | <1 |
| 1,176 | walleye | human health | CTE hazard index of 1.0 | recreational angler | 9 | 2 | <1 | <1 | <1 | <1 |
| 1,060 | walleye | human health | RME $10^{-4}$ cancer risk level | recreational angler | 9 | 2 | <1 | <1 | <1 | <1 |
| 710 | walleye | human health | RME $10^{-4}$ cancer risk level | high-intake fish consumer | 17 | 9 | <1 | <1 | <1 | <1 |
| 706 | walleye | human health | CTE $10^{-5}$ cancer risk level | recreational angler | 17 | 9 | <1 | <1 | <1 | <1 |
| 588 | walleye | human health | CTE hazard index of 1.0 | high-intake fish consumer | 20 | 9 | <1 | <1 | <1 | <1 |
| 377 | carp | human health | CTE hazard index of 1.0 | recreational angler | 39 | 26 | 4 | 2 | <1 | <1 |
| 371 | walleye | human health | CTE $10^{-5}$ cancer risk level | high-intake fish consumer | 34 | 17 | 2 | <1 | <1 | <1 |
| 340 | carp | human health | RME $10^{-4}$ cancer risk level | recreational angler | 42 | 30 | 5 | 3 | <1 | <1 |
| 288 | walleye | human health | RME hazard index of 1.0 | recreational angler | 40 | 26 | 4 | <1 | <1 | <1 |
| 230 | carp | human health | RME $10^{-4}$ cancer risk level | high-intake fish consumer | 55 | 37 | 9 | 7 | 2 | <1 |
| 226 | carp | human health | CTE $10^{-5}$ cancer risk level | recreational angler | 55 | 39 | 9 | 7 | 2 | <1 |
| 189 | carp | human health | CTE hazard index of 1.0 | high-intake fish consumer | 62 | 42 | 12 | 9 | 4 | 2 |
| 181 | walleye | human health | RME hazard index of 1.0 | high-intake fish consumer | 55 | 37 | 7 | 5 | 2 | <1 |
| 119 | carp | human health | CTE $10^{-5}$ cancer risk level | high-intake fish consumer | 76 | 55 | 17 | 15 | 9 | 7 |
| 106 | walleye | human health | RME $10^{-5}$ cancer risk level | recreational angler | 70 | 42 | 14 | 11 | 7 | 5 |
| 92 | carp | human health | RME hazard index of 1.0 | recreational angler | 87 | 65 | 21 | 17 | 12 | 6 |
| 71 | walleye | human health | RME $10^{-5}$ cancer risk level; CTE $10^{-6}$ cancer risk level | high-intake fish consumer; recreational angler | 89 | 65 | 17 | 15 | 9 | 8 |
| 58 | carp | human health | RME hazard index of 1.0 | high-intake fish consumer | 78 | 84 | 30 | 25 | 17 | 14 |
| 37 | walleye | human health | CTE $10^{-6}$ cancer risk level | high-intake fish consumer | 100 | 92 | 33 | 26 | 17 | 14 |
| 34 | carp | human health | RME $10^{-5}$ cancer risk level | recreational angler | >100 | 100 | 43 | 37 | 23 | 14 |
| 23 | carp | human health | RME $10^{-5}$ cancer risk level; CTE $10^{-6}$ cancer risk level | high-intake fish consumer; recreational angler | >100 | 100 | 57 | 45 | 29 | 23 |
| 12 | carp | human health | CTE $10^{-6}$ cancer risk level | high-intake fish consumer | >100 | >100 | 80 | 65 | 42 | 35 |
| 11 | walleye | human health | RME $10^{-6}$ cancer risk level | recreational angler | >100 | 100 | 70 | 55 | 34 | 27 |
| 7 | walleye | human health | RME $10^{-6}$ cancer risk level | high-intake fish consumer | >100 | >100 | 89 | 80 | 50 | 42 |
| 3 | carp | human health | RME $10^{-6}$ cancer risk level | recreational angler | >100 | >100 | >100 | >100 | >100 | 60 |
| 2 | carp | human health | RME $10^{-6}$ cancer risk level | high-intake fish consumer | >100 | >100 | >100 | >100 | >100 | 81 |
| 7,600 | walleye | ecological | LOAEC | fish | <1 | <1 | <1 | <1 | <1 | <1 |
| 7,600 | carp | ecological | LOAEC | fish | <1 | <1 | <1 | <1 | <1 | <1 |
| 4,083 | gizzard shad | ecological | LOAEC | piscivorous bird deformity | <1 | <1 | <1 | <1 | <1 | <1 |
| 3,879 | gizzard shad | ecological | LOAEC | piscivorous bird hatching success | <1 | <1 | <1 | <1 | <1 | <1 |
| 2,399 | gizzard shad | ecological | NOAEC | piscivorous bird hatching success | <1 | <1 | <1 | <1 | <1 | <1 |
| 1,207 | carp | ecological | LOAEC | carnivorous bird deformity | 12 | 4 | <1 | <1 | <1 | <1 |
| 1,147 | carp | ecological | LOAEC | carnivorous bird hatching success | 12 | 5 | <1 | <1 | <1 | <1 |
| 760 | walleye | ecological | NOAEC | fish | 15 | 8 | <1 | <1 | <1 | <1 |
| 760 | carp | ecological | NOAEC | fish | 20 | 11 | <1 | <1 | <1 | <1 |
| 709 | carp | ecological | NOAEC | carnivorous bird hatching success | 21 | 12 | <1 | <1 | <1 | <1 |
| 500 | carp | ecological | LOAEC | piscivorous mammal | 33 | 17 | 2 | <1 | <1 | <1 |
| 408 | gizzard shad | ecological | NOAEC | piscivorous bird deformity | <1 | <1 | <1 | <1 | <1 | <1 |
| 121 | carp | ecological | NOAEC | carnivorous bird deformity | 71 | 55 | 17 | 15 | 9 | 7 |
| 50 | carp | ecological | NOAEC | piscivorous mammal | 100 | 89 | 34 | 29 | 18 | 15 |
| 771 | sediment | ecological | TEL | sediment invertebrate | 81 | 63 | 28 | 24 | 16 | 13 |

**Notes:**

[1] Sediment concentration is presented in units of mg/kg OC.

[2] Fish concentrations are whole body.

CTE - Central Tendency Exposure

LOAEC - Lowest Observed Adverse Effect Concentration

NOAEC - No Observed Adverse Effect Concentration

RME - Reasonable Maximum Exposure

TEL - Threshold Effect Level

# Table 8-8 Remedial Action Levels and Attainment of Human Health and Ecological Thresholds (Years until Thresholds Are Met): Little Rapids to De Pere Reach

| Media Threshold Concentration (µg/kg) [1] | Media [2] | Threshold Type | Risk Level | Receptor | Remedial Action Level (ppb) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | No Action | 5,000 | 1,000 | 500 | 250 | 125 |
| 7,060 | walleye | human health | CTE $10^{-4}$ cancer risk level | recreational angler | <1 | <1 | <1 | <1 | <1 | <1 |
| 3,710 | walleye | human health | CTE $10^{-4}$ cancer risk level | high-intake fish consumer | 2 | <1 | <1 | <1 | <1 | <1 |
| 2,260 | carp | human health | CTE $10^{-4}$ cancer risk level | recreational angler | 4 | <1 | <1 | <1 | <1 | <1 |
| 1,190 | carp | human health | CTE $10^{-4}$ cancer risk level | high-intake fish consumer | 30 | 4 | <1 | <1 | <1 | <1 |
| 1,176 | walleye | human health | CTE hazard index of 1.0 | recreational angler | 30 | 10 | <1 | <1 | <1 | <1 |
| 1,060 | walleye | human health | RME $10^{-4}$ cancer risk level | recreational angler | 34 | 14 | <1 | <1 | <1 | <1 |
| 710 | walleye | human health | RME $10^{-4}$ cancer risk level | high-intake fish consumer | 51 | 20 | 2 | <1 | <1 | <1 |
| 706 | walleye | human health | CTE $10^{-5}$ cancer risk level | recreational angler | 51 | 20 | 2 | <1 | <1 | <1 |
| 588 | walleye | human health | CTE hazard index of 1.0 | high-intake fish consumer | 59 | 29 | 2 | <1 | <1 | <1 |
| 377 | carp | human health | CTE hazard index of 1.0 | recreational angler | 70 | 34 | 4 | <1 | <1 | <1 |
| 371 | walleye | human health | CTE $10^{-5}$ cancer risk level | high-intake fish consumer | 80 | 42 | 8 | 2 | <1 | <1 |
| 340 | carp | human health | RME $10^{-4}$ cancer risk level | recreational angler | 77 | 38 | 5 | <1 | <1 | <1 |
| 288 | walleye | human health | RME hazard index of 1.0 | recreational angler | 92 | 52 | 9 | 5 | 2 | 2 |
| 230 | carp | human health | RME $10^{-4}$ cancer risk level | high-intake fish consumer | 100 | 52 | 9 | 2 | <1 | <1 |
| 226 | carp | human health | CTE $10^{-5}$ cancer risk level | recreational angler | 100 | 52 | 9 | 4 | <1 | <1 |
| 189 | carp | human health | CTE hazard index of 1.0 | high-intake fish consumer | >100 | 58 | 14 | 5 | 2 | <1 |
| 181 | walleye | human health | RME hazard index of 1.0 | high-intake fish consumer | >100 | 67 | 17 | 12 | 7 | 4 |
| 119 | carp | human health | CTE $10^{-5}$ cancer risk level | high-intake fish consumer | >100 | 77 | 22 | 14 | 9 | 4 |
| 106 | walleye | human health | RME $10^{-5}$ cancer risk level | recreational angler | >100 | 92 | 30 | 20 | 14 | 9 |
| 92 | carp | human health | RME hazard index of 1.0 | recreational angler | >100 | 90 | 30 | 17 | 12 | 7 |
| 71 | walleye | human health | RME $10^{-5}$ cancer risk level; CTE $10^{-6}$ cancer risk level | high-intake fish consumer; recreational angler | >100 | 100 | 42 | 29 | 20 | 15 |
| 58 | carp | human health | RME hazard index of 1.0 | high-intake fish consumer | >100 | >100 | 40 | 27 | 20 | 14 |
| 37 | walleye | human health | CTE $10^{-6}$ cancer risk level | high-intake fish consumer | >100 | >100 | 62 | 45 | 36 | 15 |
| 34 | carp | human health | RME $10^{-5}$ cancer risk level | recreational angler | >100 | >100 | 55 | 42 | 34 | 20 |
| 23 | carp | human health | RME $10^{-5}$ cancer risk level; CTE $10^{-6}$ cancer risk level | high-intake fish consumer; recreational angler | >100 | >100 | 67 | 54 | 43 | 25 |
| 12 | carp | human health | CTE $10^{-6}$ cancer risk level | high-intake fish consumer | >100 | >100 | 90 | 80 | 65 | 45 |
| 11 | walleye | human health | RME $10^{-6}$ cancer risk level | recreational angler | >100 | >100 | 100 | 92 | 79 | 55 |
| 7 | walleye | human health | RME $10^{-6}$ cancer risk level | high-intake fish consumer | >100 | >100 | >100 | >100 | >100 | 70 |
| 3 | carp | human health | RME $10^{-6}$ cancer risk level | recreational angler | >100 | >100 | >100 | >100 | >100 | 95 |
| 2 | carp | human health | RME $10^{-6}$ cancer risk level | high-intake fish consumer | >100 | >100 | >100 | >100 | >100 | >100 |
| 7,600 | walleye | ecological | LOAEC | fish | <1 | <1 | <1 | <1 | <1 | <1 |
| 7,600 | carp | ecological | LOAEC | fish | <1 | <1 | <1 | <1 | <1 | <1 |
| 4,083 | gizzard shad | ecological | LOAEC | piscivorous bird deformity | <1 | <1 | <1 | <1 | <1 | <1 |
| 3,879 | gizzard shad | ecological | LOAEC | piscivorous bird hatching success | <1 | <1 | <1 | <1 | <1 | <1 |
| 2,399 | gizzard shad | ecological | NOAEC | piscivorous bird hatching success | <1 | <1 | <1 | <1 | <1 | <1 |
| 1,207 | carp | ecological | LOAEC | carnivorous bird deformity | 20 | 4 | <1 | <1 | <1 | <1 |
| 1,147 | carp | ecological | LOAEC | carnivorous bird hatching success | 22 | 5 | <1 | <1 | <1 | <1 |
| 760 | walleye | ecological | NOAEC | fish | 45 | 20 | <1 | <1 | <1 | <1 |
| 760 | carp | ecological | NOAEC | fish | 39 | 14 | <1 | <1 | <1 | <1 |
| 709 | carp | ecological | NOAEC | carnivorous bird hatching success | 42 | 15 | <1 | <1 | <1 | <1 |
| 500 | carp | ecological | LOAEC | piscivorous mammal | 61 | 25 | 2 | <1 | <1 | <1 |
| 408 | gizzard shad | ecological | NOAEC | piscivorous bird deformity | 2 | <1 | <1 | <1 | <1 | <1 |
| 121 | carp | ecological | NOAEC | carnivorous bird deformity | >100 | 76 | 22 | 12 | 8 | 4 |
| 50 | carp | ecological | NOAEC | piscivorous mammal | >100 | >100 | 43 | 31 | 25 | 15 |
| 596 | sediment | ecological | TEL | sediment invertebrate | >100 | >100 | 46 | 33 | 28 | 16 |

**Notes:**

[1] Sediment concentration is presented in units of mg/kg OC.

[2] Fish concentrations are whole body.

CTE - Central Tendency Exposure

LOAEC - Lowest Observed Adverse Effect Concentration

NOAEC - No Observed Adverse Effect Concentration

RME - Reasonable Maximum Exposure

TEL - Threshold Effect Level

# Table 8-9 Remedial Action Levels and Attainment of Human Health and Ecological Thresholds (Years until Thresholds Are Met): De Pere to Green Bay Reach

| Media Threshold Concentration (µg/kg) [1] | Media [2] | Threshold Type | Risk Level | Receptor | Remedial Action Level (ppb) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | No Action | 5,000 | 1,000 | 500 | 250 | 125 |
| 7,060 | walleye | human health | CTE $10^{-4}$ cancer risk level | recreational angler | <1 | <1 | <1 | <1 | <1 | <1 |
| 3,710 | walleye | human health | CTE $10^{-4}$ cancer risk level | high-intake fish consumer | 100 | 4 | <1 | <1 | <1 | <1 |
| 2,260 | carp | human health | CTE $10^{-4}$ cancer risk level | recreational angler | >100 | <1 | <1 | <1 | <1 | <1 |
| 1,190 | carp | human health | CTE $10^{-4}$ cancer risk level | high-intake fish consumer | >100 | 8 | <1 | <1 | <1 | <1 |
| 1,176 | walleye | human health | CTE hazard index of 1.0 | recreational angler | >100 | 27 | 2 | <1 | <1 | <1 |
| 1,060 | walleye | human health | RME $10^{-4}$ cancer risk level | recreational angler | >100 | 36 | 4 | <1 | <1 | <1 |
| 710 | walleye | human health | RME $10^{-4}$ cancer risk level | high-intake fish consumer | >100 | 42 | 7 | 4 | 2 | 2 |
| 706 | walleye | human health | CTE $10^{-5}$ cancer risk level | recreational angler | >100 | 42 | 7 | 4 | 2 | 2 |
| 588 | walleye | human health | CTE hazard index of 1.0 | high-intake fish consumer | >100 | 51 | 9 | 5 | 4 | 2 |
| 377 | carp | human health | CTE hazard index of 1.0 | recreational angler | >100 | 22 | 5 | <1 | <1 | <1 |
| 371 | walleye | human health | CTE $10^{-5}$ cancer risk level | high-intake fish consumer | >100 | 65 | 15 | 9 | 7 | 4 |
| 340 | carp | human health | RME $10^{-4}$ cancer risk level | recreational angler | >100 | 38 | 5 | 2 | <1 | <1 |
| 288 | walleye | human health | RME hazard index of 1.0 | recreational angler | >100 | 79 | 20 | 14 | 8 | 7 |
| 230 | carp | human health | RME $10^{-4}$ cancer risk level | high-intake fish consumer | >100 | 52 | 10 | 5 | 2 | 2 |
| 226 | carp | human health | CTE $10^{-5}$ cancer risk level | recreational angler | >100 | 52 | 11 | 5 | 2 | 2 |
| 189 | carp | human health | CTE hazard index of 1.0 | high-intake fish consumer | >100 | 100 | 14 | 7 | 4 | 2 |
| 181 | walleye | human health | RME hazard index of 1.0 | high-intake fish consumer | >100 | 100 | 30 | 20 | 14 | 7 |
| 119 | carp | human health | CTE $10^{-5}$ cancer risk level | high-intake fish consumer | >100 | 79 | 20 | 14 | 8 | 5 |
| 106 | walleye | human health | RME $10^{-5}$ cancer risk level | recreational angler | >100 | 100 | 45 | 34 | 20 | 15 |
| 92 | carp | human health | RME hazard index of 1.0 | recreational angler | >100 | 92 | 29 | 17 | 9 | 7 |
| 71 | walleye | human health | RME $10^{-5}$ cancer risk level; CTE $10^{-6}$ cancer risk level | high-intake fish consumer; recreational angler | >100 | 100 | 59 | 45 | 29 | 20 |
| 58 | carp | human health | RME hazard index of 1.0 | high-intake fish consumer | >100 | 100 | 54 | 29 | 17 | 11 |
| 37 | walleye | human health | CTE $10^{-6}$ cancer risk level | high-intake fish consumer | >100 | >100 | 80 | 70 | 51 | 31 |
| 34 | carp | human health | RME $10^{-5}$ cancer risk level | recreational angler | >100 | >100 | 58 | 45 | 27 | 17 |
| 23 | carp | human health | RME $10^{-5}$ cancer risk level; CTE $10^{-6}$ cancer risk level | high-intake fish consumer; recreational angler | >100 | >100 | 70 | 59 | 38 | 22 |
| 12 | carp | human health | CTE $10^{-6}$ cancer risk level | high-intake fish consumer | >100 | >100 | 92 | 87 | 61 | 42 |
| 11 | walleye | human health | RME $10^{-6}$ cancer risk level | recreational angler | >100 | >100 | 100 | 100 | 100 | 77 |
| 7 | walleye | human health | RME $10^{-6}$ cancer risk level | high-intake fish consumer | >100 | >100 | >100 | >100 | >100 | >100 |
| 3 | carp | human health | RME $10^{-6}$ cancer risk level | recreational angler | >100 | >100 | >100 | >100 | >100 | >100 |
| 2 | carp | human health | RME $10^{-6}$ cancer risk level | high-intake fish consumer | >100 | >100 | >100 | >100 | >100 | >100 |
| 7,600 | walleye | ecological | LOAEC | fish | 91 | <1 | <1 | <1 | <1 | <1 |
| 7,600 | carp | ecological | LOAEC | fish | 8 | <1 | <1 | <1 | <1 | <1 |
| 4,083 | alewife | ecological | LOAEC | piscivorous bird deformity | <1 | <1 | <1 | <1 | <1 | <1 |
| 3,879 | alewife | ecological | LOAEC | piscivorous bird hatching success | <1 | <1 | <1 | <1 | <1 | <1 |
| 2,399 | alewife | ecological | NOAEC | piscivorous bird hatching success | <1 | <1 | <1 | <1 | <1 | <1 |
| 1,207 | carp | ecological | LOAEC | carnivorous bird deformity | >100 | 7 | <1 | <1 | <1 | <1 |
| 1,147 | carp | ecological | LOAEC | carnivorous bird hatching success | >100 | 8 | <1 | <1 | <1 | <1 |
| 760 | walleye | ecological | NOAEC | fish | >100 | 42 | 7 | 4 | 2 | <1 |
| 760 | carp | ecological | NOAEC | fish | >100 | 15 | <1 | <1 | <1 | <1 |
| 709 | carp | ecological | NOAEC | carnivorous bird hatching success | >100 | 17 | <1 | <1 | <1 | <1 |
| 500 | carp | ecological | LOAEC | piscivorous mammal | >100 | 27 | 2 | <1 | <1 | <1 |
| 408 | alewife | ecological | NOAEC | piscivorous bird deformity | 100 | 9 | <1 | <1 | <1 | <1 |
| 121 | carp | ecological | NOAEC | carnivorous bird deformity | >100 | 79 | 20 | 14 | 7 | 5 |
| 50 | carp | ecological | NOAEC | piscivorous mammal | >100 | 100 | 45 | 34 | 17 | 14 |
| 632 | sediment | ecological | TEL | sediment invertebrate | >100 | 93 | 37 | 23 | 13 | 6 |

**Notes:**

[1] Sediment concentration is presented in units of mg/kg OC.

[2] Fish concentrations are whole body.

CTE - Central Tendency Exposure

LOAEC - Lowest Observed Adverse Effect Concentration

NOAEC - No Observed Adverse Effect Concentration

RME - Reasonable Maximum Exposure

TEL - Threshold Effect Level

# Table 8-10 Remedial Action Levels and Attainment of Human Health and Ecological Thresholds (Years until Thresholds Are Met): Green Bay Zone 2

**A. Organized by Fox River Remedial Action Level**

| Media Threshold Concentration (µg/kg) [1] | Media [2] | Threshold Type | Risk Level | Receptor | Fox River No Action | Fox River 5,000 ppb | Fox River 1,000 ppb | | Fox River 500 ppb | | | Fox River 250 ppb | | | Fox River 125 ppb | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Green Bay | Green Bay | Green Bay (ppb) | | Green Bay (ppb) | | | Green Bay (ppb) | | | Green Bay (ppb) | | |
| | | | | | No Action | No Action | No Action | 1,000 | No Action | 1,000 | 500 | No Action | 1,000 | 500 | No Action | 1,000 | 500 |
| 7,060 | walleye | human health | CTE $10^{-4}$ cancer risk level | recreational angler | 45 | 34 | 32 | < 1 | 32 | < 1 | < 1 | 32 | < 1 | < 1 | 32 | < 1 | < 1 |
| 3,710 | walleye | human health | CTE $10^{-4}$ cancer risk level | high-intake fish consumer | 83 | 62 | 60 | 3 | 60 | 2 | 2 | 60 | 2 | 2 | 60 | 2 | < 1 |
| 1,176 | walleye | human health | CTE hazard index of 1.0 | recreational angler | >100 | >100 | >100 | 61 | >100 | 59 | 55 | >100 | 58 | 54 | >100 | 58 | 53 |
| 1,060 | walleye | human health | RME $10^{-4}$ cancer risk level | recreational angler | >100 | >100 | >100 | 75 | >100 | 75 | 71 | >100 | 74 | 70 | >100 | 74 | 69 |
| 710 | walleye | human health | RME $10^{-4}$ cancer risk level | high-intake fish consumer | >100 | > 100 | >100 | 99 | >100 | 99 | 99 | >100 | 99 | 99 | >100 | 99 | 99 |
| 706 | walleye | human health | CTE $10^{-5}$ cancer risk level | recreational angler | >100 | > 100 | >100 | 99 | >100 | 99 | 99 | >100 | 99 | 99 | >100 | 99 | 99 |
| 588 | walleye | human health | CTE hazard index of 1.0 | high-intake fish consumer | >100 | > 100 | >100 | >100 | >100 | >100 | 99 | >100 | 99 | 99 | >100 | 99 | 99 |
| 371 | walleye | human health | CTE $10^{-5}$ cancer risk level | high-intake fish consumer | >100 | > 100 | >100 | > 100 | >100 | >100 | > 100 | >100 | >100 | >100 | >100 | >100 | >100 |
| 288 | walleye | human health | RME hazard index of 1.0 | recreational angler | >100 | > 100 | >100 | > 100 | >100 | >100 | > 100 | >100 | >100 | >100 | >100 | >100 | >100 |
| 181 | walleye | human health | RME hazard index of 1.0 | high-intake fish consumer | >100 | > 100 | >100 | > 100 | >100 | >100 | > 100 | >100 | >100 | >100 | >100 | >100 | >100 |
| 106 | walleye | human health | RME $10^{-5}$ cancer risk level | recreational angler | >100 | > 100 | >100 | > 100 | >100 | >100 | > 100 | >100 | >100 | >100 | >100 | >100 | >100 |
| 71 | walleye | human health | RME $10^{-5}$ cancer risk level; RME $10^{-6}$ cancer risk level | high-intake fish consumer; recreational angler | >100 | > 100 | >100 | > 100 | >100 | >100 | > 100 | >100 | >100 | >100 | >100 | >100 | >100 |
| 37 | walleye | human health | CTE $10^{-6}$ cancer risk level | high-intake fish consumer | >100 | > 100 | >100 | > 100 | >100 | >100 | > 100 | >100 | >100 | >100 | >100 | >100 | >100 |
| 11 | walleye | human health | RME $10^{-6}$ cancer risk level | recreational angler | >100 | > 100 | >100 | > 100 | >100 | >100 | > 100 | >100 | >100 | >100 | >100 | >100 | >100 |
| 7 | walleye | human health | RME $10^{-6}$ cancer risk level | high-intake fish consumer | >100 | > 100 | >100 | > 100 | >100 | >100 | > 100 | >100 | >100 | >100 | >100 | >100 | >100 |
| 7,600 | walleye | ecological | LOAEC | fish | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 7,600 | alewife | ecological | LOAEC | fish | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 4,083 | alewife | ecological | LOAEC | piscivorous bird deformity | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 3,879 | alewife | ecological | LOAEC | piscivorous bird hatching success | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 2,399 | alewife | ecological | NOAEC | piscivorous bird hatching success | 30 | 24 | 23 | 3 | 23 | < 1 | < 1 | 23 | < 1 | < 1 | 23 | < 1 | < 1 |
| 1,207 | walleye | ecological | LOAEC | carnivorous bird deformity | >100 | >100 | >100 | 57 | >100 | 55 | 51 | >100 | 54 | 50 | >100 | 54 | 50 |
| 1,147 | walleye | ecological | LOAEC | carnivorous bird hatching success | >100 | >100 | >100 | 64 | >100 | 63 | 59 | >100 | 62 | 58 | >100 | 62 | 57 |
| 760 | walleye | ecological | NOAEC | fish | >100 | > 100 | >100 | 40 | >100 | 39 | 34 | >100 | 38 | 33 | >100 | 37 | 33 |
| 760 | alewife | ecological | NOAEC | fish | >100 | 75 | 74 | 7 | 73 | 6 | 5 | 73 | 6 | 5 | 73 | 6 | 5 |
| 709 | walleye | ecological | NOAEC | carnivorous bird hatching success | >100 | > 100 | >100 | 99 | >100 | 99 | 99 | >100 | 99 | 99 | >100 | 99 | 99 |
| 500 | walleye | ecological | LOAEC | mink | >100 | > 100 | >100 | 94 | >100 | 94 | 91 | >100 | 93 | 90 | >100 | 93 | 90 |
| 500 | alewife | ecological | LOAEC | mink | >100 | 80 | 83 | 10 | 80 | 10 | 9 | 80 | 10 | 8 | 80 | 9 | 8 |
| 408 | alewife | ecological | NOAEC | piscivorous bird deformity | >100 | >100 | >100 | 30 | >100 | 29 | 26 | >100 | 28 | 25 | >100 | 28 | 25 |
| 121 | walleye | ecological | NOAEC | carnivorous bird deformity | >100 | > 100 | >100 | > 100 | >100 | >100 | > 100 | >100 | >100 | >100 | >100 | >100 | >100 |
| 50 | walleye | ecological | NOAEC | mink | >100 | > 100 | >100 | > 100 | >100 | >100 | > 100 | >100 | >100 | >100 | >100 | >100 | >100 |
| 50 | alewife | ecological | NOAEC | mink | >100 | > 100 | >100 | > 100 | >100 | >100 | > 100 | >100 | >100 | >100 | >100 | >100 | >100 |

# Table 8-10 Remedial Action Levels and Attainment of Human Health and Ecological Thresholds (Years until Thresholds Are Met): Green Bay Zone 2 (Continued)

**B. Organized by Green Bay Remedial Action Level**

| Media Threshold Concentration (µg/kg) [1] | Media [2] | Threshold Type | Risk Level | Receptor | Green Bay No Action | | | | | | Green Bay 1,000 ppb | | | | Green Bay 500 ppb | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Fox River (ppb) | | | | | | Fox River (ppb) | | | | Fox River (ppb) | | |
| | | | | | No Action | 5,000 | 1,000 | 500 | 250 | 125 | 1,000 | 500 | 250 | 125 | 500 | 250 | 125 |
| 7,060 | walleye | human health | CTE $10^{-4}$ cancer risk level | recreational angler | 45 | 34 | 32 | 32 | 32 | 32 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 3,710 | walleye | human health | CTE $10^{-4}$ cancer risk level | high-intake fish consumer | 83 | 62 | 60 | 60 | 60 | 60 | 3 | 2 | 2 | 2 | < 1 | 2 | < 1 |
| 1,176 | walleye | human health | CTE hazard index of 1.0 | recreational angler | >100 | >100 | >100 | >100 | >100 | >100 | 61 | 59 | 58 | 58 | 55 | 54 | 53 |
| 1,060 | walleye | human health | RME $10^{-4}$ cancer risk level | recreational angler | >100 | >100 | >100 | >100 | >100 | >100 | 75 | 75 | 74 | 74 | 71 | 70 | 69 |
| 710 | walleye | human health | RME $10^{-4}$ cancer risk level | high-intake fish consumer | >100 | >100 | > 100 | >100 | >100 | >100 | 99 | 99 | 99 | 99 | 99 | 99 | 99 |
| 706 | walleye | human health | CTE $10^{-5}$ cancer risk level | recreational angler | >100 | >100 | > 100 | >100 | >100 | >100 | 99 | 99 | 99 | 99 | 99 | 99 | 99 |
| 588 | walleye | human health | CTE hazard index of 1.0 | high-intake fish consumer | >100 | >100 | > 100 | >100 | >100 | >100 | >100 | >100 | 99 | 99 | 99 | 99 | 99 |
| 371 | walleye | human health | CTE $10^{-5}$ cancer risk level | high-intake fish consumer | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 |
| 288 | walleye | human health | RME hazard index of 1.0 | recreational angler | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 |
| 181 | walleye | human health | RME hazard index of 1.0 | high-intake fish consumer | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 |
| 106 | walleye | human health | RME $10^{-5}$ cancer risk level | recreational angler | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 |
| 71 | walleye | human health | RME $10^{-5}$ cancer risk level; RME $10^{-6}$ cancer risk level | high-intake fish consumer; recreational angler | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 |
| 37 | walleye | human health | CTE $10^{-6}$ cancer risk level | high-intake fish consumer | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 |
| 11 | walleye | human health | RME $10^{-6}$ cancer risk level | recreational angler | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 |
| 7 | walleye | human health | RME $10^{-6}$ cancer risk level | high-intake fish consumer | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 |
| 7,600 | walleye | ecological | LOAEC | fish | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 7,600 | alewife | ecological | LOAEC | fish | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 4,083 | alewife | ecological | LOAEC | piscivorous bird deformity | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 3,879 | alewife | ecological | LOAEC | piscivorous bird hatching success | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 2,399 | alewife | ecological | NOAEC | piscivorous bird hatching success | 30 | 24 | 23 | 23 | 23 | 23 | 3 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 1,207 | walleye | ecological | LOAEC | carnivorous bird deformity | >100 | >100 | >100 | >100 | >100 | 89 | 57 | 55 | 54 | 54 | 51 | 50 | 50 |
| 1,147 | walleye | ecological | LOAEC | carnivorous bird hatching success | >100 | >100 | >100 | >100 | >100 | >100 | 64 | 63 | 62 | 62 | 59 | 58 | 57 |
| 760 | walleye | ecological | NOAEC | fish | >100 | >100 | > 100 | >100 | >100 | >100 | 40 | 39 | 38 | 37 | 34 | 33 | 33 |
| 760 | alewife | ecological | NOAEC | fish | >100 | 75 | 74 | 73 | 73 | 73 | 7 | 6 | 6 | 6 | 5 | 5 | 5 |
| 709 | walleye | ecological | NOAEC | carnivorous bird hatching success | >100 | >100 | > 100 | >100 | >100 | >100 | 99 | 99 | 99 | 99 | 99 | 99 | 99 |
| 500 | walleye | ecological | LOAEC | mink | >100 | >100 | > 100 | >100 | >100 | >100 | 94 | 94 | 93 | 93 | 91 | 90 | 90 |
| 500 | alewife | ecological | LOAEC | mink | >100 | 83 | 80 | 80 | 80 | 80 | 10 | 10 | 10 | 9 | 9 | 8 | 8 |
| 408 | alewife | ecological | NOAEC | piscivorous bird deformity | >100 | >100 | >100 | >100 | >100 | >100 | 30 | 29 | 28 | 28 | 26 | 25 | 25 |
| 121 | walleye | ecological | NOAEC | carnivorous bird deformity | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 |
| 50 | walleye | ecological | NOAEC | mink | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 |
| 50 | alewife | ecological | NOAEC | mink | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 |

# Table 8-11 Remedial Action Levels and Attainment of Human Health and Ecological Thresholds (Years until Thresholds Are Met): Green Bay Zone 3A

**A. Organized by Fox River Remedial Action Level**

| Media Threshold Concentration (µg/kg)[1] | Media[2] | Threshold Type | Risk Level | Receptor | Fox River No Action | Fox River 5,000 ppb | Fox River 1,000 ppb | | Fox River 500 ppb | | | Fox River 250 ppb | | | Fox River 125 ppb | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Green Bay No Action | Green Bay No Action | Green Bay (ppb) | | Green Bay (ppb) | | | Green Bay (ppb) | | | Green Bay (ppb) | | |
| | | | | | | | No Action | 1,000 | No Action | 1,000 | 500 | No Action | 1,000 | 500 | No Action | 1,000 | 500 |
| 7,060 | walleye | human health | CTE $10^{-4}$ cancer risk level | recreational angler | 2 | 2 | 2 | < 1 | 2 | < 1 | < 1 | 2 | < 1 | >100 | 2 | < 1 | < 1 |
| 3,710 | walleye | human health | CTE $10^{-4}$ cancer risk level | high-intake fish consumer | 25 | 19 | 18 | 5 | 18 | 5 | 4 | 18 | 5 | 4 | 18 | 5 | 4 |
| 1,176 | walleye | human health | CTE hazard index of 1.0 | recreational angler | 99 | 99 | 99 | 60 | 99 | 60 | 55 | 99 | 60 | 55 | 99 | 60 | 55 |
| 1,060 | walleye | human health | RME $10^{-4}$ cancer risk level | recreational angler | 99 | 99 | 99 | 75 | 99 | 74 | 70 | 99 | 74 | 69 | 99 | 74 | 69 |
| 710 | walleye | human health | RME $10^{-4}$ cancer risk level | high-intake fish consumer | >100 | 90 | 89 | >100 | 88 | >100 | >100 | 88 | >100 | >100 | 88 | >100 | >100 |
| 706 | walleye | human health | CTE $10^{-5}$ cancer risk level | recreational angler | >100 | 91 | 89 | >100 | 89 | >100 | >100 | 89 | 36 | >100 | 89 | >100 | >100 |
| 588 | walleye | human health | CTE hazard index of 1.0 | high-intake fish consumer | >100 | >100 | > 100 | >100 | >100 | >100 | >100 | >100 | 57 | >100 | >100 | 57 | >100 |
| 371 | walleye | human health | CTE $10^{-5}$ cancer risk level | high-intake fish consumer | >100 | >100 | > 100 | > 100 | >100 | >100 | > 100 | >100 | >100 | >100 | >100 | >100 | >100 |
| 288 | walleye | human health | RME hazard index of 1.0 | recreational angler | >100 | >100 | > 100 | > 100 | >100 | >100 | > 100 | >100 | >100 | >100 | >100 | >100 | >100 |
| 181 | walleye | human health | RME hazard index of 1.0 | high-intake fish consumer | >100 | >100 | > 100 | > 100 | >100 | >100 | > 100 | >100 | >100 | >100 | >100 | >100 | >100 |
| 106 | walleye | human health | RME $10^{-5}$ cancer risk level | recreational angler | >100 | >100 | > 100 | > 100 | >100 | >100 | > 100 | >100 | >100 | >100 | >100 | >100 | >100 |
| 71 | walleye | human health | RME $10^{-5}$ cancer risk level; RME $10^{-6}$ cancer risk level | high-intake fish consumer; recreational angler | >100 | >100 | > 100 | > 100 | >100 | >100 | > 100 | >100 | >100 | >100 | >100 | >100 | >100 |
| 37 | walleye | human health | CTE $10^{-6}$ cancer risk level | high-intake fish consumer | >100 | >100 | > 100 | > 100 | >100 | >100 | > 100 | >100 | >100 | >100 | >100 | >100 | >100 |
| 11 | walleye | human health | RME $10^{-6}$ cancer risk level | recreational angler | >100 | >100 | > 100 | > 100 | >100 | >100 | > 100 | >100 | >100 | >100 | >100 | >100 | >100 |
| 7 | walleye | human health | RME $10^{-6}$ cancer risk level | high-intake fish consumer | >100 | >100 | > 100 | > 100 | >100 | >100 | > 100 | >100 | >100 | >100 | >100 | >100 | >100 |
| 7,600 | walleye | ecological | LOAEC | fish | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 7,600 | alewife | ecological | LOAEC | fish | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 4,083 | alewife | ecological | LOAEC | piscivorous bird deformity | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 3,879 | alewife | ecological | LOAEC | piscivorous bird hatching success | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 2,399 | alewife | ecological | NOAEC | piscivorous bird hatching success | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 1,207 | walleye | ecological | LOAEC | carnivorous bird deformity | 99 | 99 | 99 | 57 | 99 | 57 | 51 | 99 | 56 | 51 | 99 | 56 | 50 |
| 1,147 | walleye | ecological | LOAEC | carnivorous bird hatching success | 99 | 99 | 99 | 64 | 99 | 63 | 59 | 99 | 63 | 58 | 99 | 63 | 58 |
| 760 | walleye | ecological | NOAEC | fish | >100 | 84 | 82 | 31 | 82 | >100 | >100 | 82 | >100 | >100 | 82 | >100 | >100 |
| 760 | alewife | ecological | NOAEC | fish | 6 | 5 | 5 | < 1 | 5 | < 1 | < 1 | 5 | 2 | < 1 | 5 | 2 | < 1 |
| 709 | walleye | ecological | NOAEC | carnivorous bird hatching success | >100 | 90 | 89 | >100 | 89 | >100 | >100 | 89 | >100 | >100 | 88 | >100 | >100 |
| 500 | walleye | ecological | LOAEC | mink | >100 | >100 | > 100 | 80 | >100 | 79 | 75 | >100 | 79 | 75 | >100 | 79 | 75 |
| 500 | alewife | ecological | LOAEC | mink | 35 | 30 | 29 | 7 | 29 | < 1 | 5 | 29 | 7 | 5 | 29 | 7 | 5 |
| 408 | alewife | ecological | NOAEC | piscivorous bird deformity | 51 | 44 | 43 | 11 | 43 | 11 | 8 | 43 | 11 | 8 | 43 | 11 | 8 |
| 121 | walleye | ecological | NOAEC | carnivorous bird deformity | >100 | >100 | > 100 | > 100 | >100 | >100 | > 100 | >100 | >100 | >100 | >100 | >100 | >100 |
| 50 | walleye | ecological | NOAEC | mink | >100 | >100 | > 100 | > 100 | >100 | >100 | > 100 | >100 | >100 | >100 | >100 | >100 | >100 |
| 50 | alewife | ecological | NOAEC | mink | >100 | >100 | > 100 | > 100 | >100 | >100 | > 100 | >100 | >100 | >100 | >100 | >100 | >100 |

# Table 8-11 Remedial Action Levels and Attainment of Human Health and Ecological Thresholds (Years until Thresholds Are Met): Green Bay Zone 3A (Continued)

**B. Organized by Green Bay Remedial Action Level**

| Media Threshold Concentration (µg/kg) [1] | Media [2] | Threshold Type | Risk Level | Receptor | Green Bay No Action | | | | | | Green Bay 1,000 ppb | | | | Green Bay 500 ppb | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Fox River (ppb) | | | | | | Fox River (ppb) | | | | Fox River (ppb) | | |
| | | | | | No Action | 5,000 | 1,000 | 500 | 250 | 125 | 1,000 | 500 | 250 | 125 | 500 | 250 | 125 |
| 7,060 | walleye | human health | CTE $10^{-4}$ cancer risk level | recreational angler | 2 | 2 | 2 | 2 | 2 | 2 | < 1 | < 1 | < 1 | < 1 | < 1 | 99 | < 1 |
| 3,710 | walleye | human health | CTE $10^{-4}$ cancer risk level | high-intake fish consumer | 25 | 19 | 18 | 18 | 18 | 18 | 5 | 5 | 5 | 5 | 4 | 4 | 4 |
| 1,176 | walleye | human health | CTE hazard index of 1.0 | recreational angler | 99 | 99 | 99 | 99 | 99 | 99 | 60 | 60 | 60 | 60 | 55 | 55 | 55 |
| 1,060 | walleye | human health | RME $10^{-4}$ cancer risk level | recreational angler | 99 | 99 | 99 | 99 | 99 | 99 | 75 | 74 | 74 | 74 | 70 | 69 | 69 |
| 710 | walleye | human health | RME $10^{-4}$ cancer risk level | high-intake fish consumer | >100 | 90 | 89 | 88 | 88 | 88 | 99 | 99 | 99 | 99 | 99 | 99 | 99 |
| 706 | walleye | human health | CTE $10^{-5}$ cancer risk level | recreational angler | >100 | 91 | 89 | 89 | 89 | 89 | 99 | 99 | 99 | 99 | 99 | 99 | 99 |
| 588 | walleye | human health | CTE hazard index of 1.0 | high-intake fish consumer | >100 | >100 | > 100 | >100 | >100 | >100 | 99 | 99 | 57 | 57 | 99 | 99 | 99 |
| 371 | walleye | human health | CTE $10^{-5}$ cancer risk level | high-intake fish consumer | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 |
| 288 | walleye | human health | RME hazard index of 1.0 | recreational angler | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 |
| 181 | walleye | human health | RME hazard index of 1.0 | high-intake fish consumer | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 |
| 106 | walleye | human health | RME $10^{-5}$ cancer risk level | recreational angler | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 |
| 71 | walleye | human health | RME $10^{-5}$ cancer risk level; RME $10^{-6}$ cancer risk level | high-intake fish consumer; recreational angler | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 |
| 37 | walleye | human health | CTE $10^{-6}$ cancer risk level | high-intake fish consumer | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 |
| 11 | walleye | human health | RME $10^{-6}$ cancer risk level | recreational angler | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 |
| 7 | walleye | human health | RME $10^{-6}$ cancer risk level | high-intake fish consumer | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 |
| 7,600 | walleye | ecological | LOAEC | fish | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 7,600 | alewife | ecological | LOAEC | fish | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 4,083 | alewife | ecological | LOAEC | piscivorous bird deformity | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 3,879 | alewife | ecological | LOAEC | piscivorous bird hatching success | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 2,399 | alewife | ecological | NOAEC | piscivorous bird hatching success | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 1,207 | walleye | ecological | LOAEC | carnivorous bird deformity | 99 | 99 | 99 | 99 | 99 | 99 | 57 | 57 | 56 | 56 | 51 | 51 | 50 |
| 1,147 | walleye | ecological | LOAEC | carnivorous bird hatching success | 99 | 99 | 99 | 99 | 99 | 99 | 64 | 63 | 63 | 63 | 59 | 58 | 58 |
| 760 | walleye | ecological | NOAEC | fish | >100 | 84 | 82 | 82 | 82 | 82 | 99 | 99 | 99 | 99 | 99 | 99 | 99 |
| 760 | alewife | ecological | NOAEC | fish | 6 | 5 | 5 | 5 | 5 | 5 | < 1 | < 1 | 2 | 2 | < 1 | < 1 | < 1 |
| 709 | walleye | ecological | NOAEC | carnivorous bird hatching success | >100 | 90 | 89 | 89 | 89 | 88 | 99 | 99 | 99 | 99 | 99 | 99 | 99 |
| 500 | walleye | ecological | LOAEC | mink | >100 | >100 | > 100 | >100 | >100 | >100 | 80 | 79 | 79 | 79 | 75 | 75 | 75 |
| 500 | alewife | ecological | LOAEC | mink | 35 | 30 | 29 | 29 | 29 | 29 | 7 | < 1 | 7 | 7 | 5 | 5 | 5 |
| 408 | alewife | ecological | NOAEC | piscivorous bird deformity | 51 | 44 | 43 | 43 | 43 | 43 | 11 | 11 | 11 | 11 | 8 | 8 | 8 |
| 121 | walleye | ecological | NOAEC | carnivorous bird deformity | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 |
| 50 | walleye | ecological | NOAEC | mink | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 |
| 50 | alewife | ecological | NOAEC | mink | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 |

# Table 8-12 Remedial Action Levels and Attainment of Human Health and Ecological Thresholds (Years until Thresholds Are Met): Green Bay Zone 3B

**A. Organized by Fox River Remedial Action Level**

| Media Threshold Concentration (µg/kg) [1] | Media [2] | Threshold Type | Risk Level | Receptor | Fox River No Action | Fox River 5,000 ppb | Fox River 1,000 ppb | Fox River 500 ppb | | Fox River 250 ppb | | Fox River 125 ppb | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Green Bay No Action | Green Bay No Action | Green Bay No Action | Green Bay (ppb) | | Green Bay (ppb) | | Green Bay (ppb) | |
| | | | | | | | | No Action | 500 | No Action | 500 | No Action | 500 |
| 7,060 | walleye | human health | CTE $10^{-4}$ cancer risk level | recreational angler | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 3,710 | walleye | human health | CTE $10^{-4}$ cancer risk level | high-intake fish consumer | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | 3 | < 1 |
| 1,176 | walleye | human health | CTE hazard index of 1.0 | recreational angler | 59 | 51 | 51 | 50 | 13 | 50 | 13 | 50 | 13 |
| 1,060 | walleye | human health | RME $10^{-4}$ cancer risk level | recreational angler | 67 | 57 | 56 | 56 | 16 | 56 | 16 | 56 | 16 |
| 710 | walleye | human health | RME $10^{-4}$ cancer risk level | high-intake fish consumer | 99 | 84 | 83 | 83 | 31 | 82 | 31 | 82 | 31 |
| 706 | walleye | human health | CTE $10^{-5}$ cancer risk level | recreational angler | 99 | 84 | 83 | 83 | 31 | 83 | 31 | 83 | 31 |
| 588 | walleye | human health | CTE hazard index of 1.0 | high-intake fish consumer | 99 | 99 | 98 | 98 | 47 | 98 | 47 | 99 | 46 |
| 371 | walleye | human health | CTE $10^{-5}$ cancer risk level | high-intake fish consumer | >100 | 97 | 95 | 95 | 98 | 95 | 99 | 95 | 98 |
| 288 | walleye | human health | RME hazard index of 1.0 | recreational angler | >100 | >100 | > 100 | >100 | 99 | >100 | 99 | >100 | 99 |
| 181 | walleye | human health | RME hazard index of 1.0 | high-intake fish consumer | >100 | >100 | > 100 | >100 | > 100 | >100 | >100 | >100 | >100 |
| 106 | walleye | human health | RME $10^{-5}$ cancer risk level | recreational angler | >100 | >100 | > 100 | >100 | > 100 | >100 | >100 | >100 | >100 |
| 71 | walleye | human health | RME $10^{-5}$ cancer risk level; RME $10^{-6}$ cancer risk level | high-intake fish consumer; recreational angler | >100 | >100 | > 100 | >100 | > 100 | >100 | >100 | >100 | >100 |
| 37 | walleye | human health | CTE $10^{-6}$ cancer risk level | high-intake fish consumer | >100 | >100 | > 100 | >100 | > 100 | >100 | >100 | >100 | >100 |
| 11 | walleye | human health | RME $10^{-6}$ cancer risk level | recreational angler | >100 | >100 | > 100 | >100 | > 100 | >100 | >100 | >100 | >100 |
| 7 | walleye | human health | RME $10^{-6}$ cancer risk level | high-intake fish consumer | >100 | >100 | > 100 | >100 | > 100 | >100 | >100 | >100 | >100 |
| 7,600 | walleye | ecological | LOAEC | fish | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 7,600 | alewife | ecological | LOAEC | fish | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 4,083 | alewife | ecological | LOAEC | piscivorous bird deformity | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 3,879 | alewife | ecological | LOAEC | piscivorous bird hatching success | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 2,399 | alewife | ecological | NOAEC | piscivorous bird hatching success | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 1,207 | walleye | ecological | LOAEC | carnivorous bird deformity | 58 | 50 | 49 | 49 | 13 | 49 | 13 | 49 | 13 |
| 1,147 | walleye | ecological | LOAEC | carnivorous bird hatching success | 62 | 53 | 52 | 52 | 14 | 52 | 14 | 52 | 14 |
| 760 | walleye | ecological | NOAEC | fish | 97 | 79 | 78 | 77 | 27 | 77 | 26 | 77 | 26 |
| 760 | alewife | ecological | NOAEC | fish | 5 | 5 | 4 | 4 | < 1 | 4 | < 1 | 4 | 1 |
| 709 | walleye | ecological | NOAEC | carnivorous bird hatching success | 99 | 84 | 83 | 83 | 31 | 83 | 31 | 83 | 31 |
| 500 | walleye | ecological | LOAEC | mink | 90 | 99 | 99 | 99 | 65 | 99 | 65 | 99 | 65 |
| 500 | alewife | ecological | LOAEC | mink | 25 | 22 | 21 | 21 | 4 | 21 | 4 | 21 | 4 |
| 408 | alewife | ecological | NOAEC | piscivorous bird deformity | 38 | 33 | 32 | 32 | 7 | 32 | 7 | 32 | 7 |
| 121 | walleye | ecological | NOAEC | carnivorous bird deformity | >100 | >100 | > 100 | >100 | > 100 | >100 | >100 | >100 | >100 |
| 50 | walleye | ecological | NOAEC | mink | >100 | >100 | > 100 | >100 | > 100 | >100 | >100 | >100 | >100 |
| 50 | alewife | ecological | NOAEC | mink | >100 | >100 | > 100 | >100 | > 100 | >100 | >100 | >100 | >100 |

# Table 8-12 Remedial Action Levels and Attainment of Human Health and Ecological Thresholds (Years until Thresholds Are Met): Green Bay Zone 3B (Continued)

**B. Organized by Green Bay Remedial Action Level**

| Media Threshold Concentration (µg/kg) [1] | Media [2] | Threshold Type | Risk Level | Receptor | Green Bay No Action | | | | | | Green Bay 500 ppb | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Fox River (ppb) | | | | | | Fox River (ppb) | | |
| | | | | | No Action | 5,000 | 1,000 | 500 | 250 | 125 | 500 | 250 | 125 |
| 7,060 | walleye | human health | CTE $10^{-4}$ cancer risk level | recreational angler | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 3,710 | walleye | human health | CTE $10^{-4}$ cancer risk level | high-intake fish consumer | 3 | 3 | 3 | 3 | 3 | 3 | < 1 | < 1 | < 1 |
| 1,176 | walleye | human health | CTE hazard index of 1.0 | recreational angler | 59 | 51 | 51 | 50 | 50 | 50 | 13 | 13 | 13 |
| 1,060 | walleye | human health | RME $10^{-4}$ cancer risk level | recreational angler | 67 | 57 | 56 | 56 | 56 | 56 | 16 | 16 | 16 |
| 710 | walleye | human health | RME $10^{-4}$ cancer risk level | high-intake fish consumer | 99 | 84 | 83 | 83 | 82 | 82 | 31 | 31 | 31 |
| 706 | walleye | human health | CTE $10^{-5}$ cancer risk level | recreational angler | 99 | 84 | 83 | 83 | 83 | 83 | 31 | 31 | 31 |
| 588 | walleye | human health | CTE hazard index of 1.0 | high-intake fish consumer | 99 | 99 | 98 | 98 | 98 | 98 | 47 | 47 | 46 |
| 371 | walleye | human health | CTE $10^{-5}$ cancer risk level | high-intake fish consumer | >100 | 97 | 95 | 95 | 95 | 95 | 98 | 98 | 98 |
| 288 | walleye | human health | RME hazard index of 1.0 | recreational angler | >100 | >100 | > 100 | >100 | >100 | >100 | 99 | 99 | 99 |
| 181 | walleye | human health | RME hazard index of 1.0 | high-intake fish consumer | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 |
| 106 | walleye | human health | RME $10^{-5}$ cancer risk level | recreational angler | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 |
| 71 | walleye | human health | RME $10^{-5}$ cancer risk level; RME $10^{-6}$ cancer risk level | high-intake fish consumer; recreational angler | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 |
| 37 | walleye | human health | CTE $10^{-6}$ cancer risk level | high-intake fish consumer | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 |
| 11 | walleye | human health | RME $10^{-6}$ cancer risk level | recreational angler | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 |
| 7 | walleye | human health | RME $10^{-6}$ cancer risk level | high-intake fish consumer | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 |
| 7,600 | walleye | ecological | LOAEC | fish | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 7,600 | alewife | ecological | LOAEC | fish | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 4,083 | alewife | ecological | LOAEC | piscivorous bird deformity | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 3,879 | alewife | ecological | LOAEC | piscivorous bird hatching success | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 2,399 | alewife | ecological | NOAEC | piscivorous bird hatching success | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 1,207 | walleye | ecological | LOAEC | carnivorous bird deformity | 58 | 50 | 49 | 49 | 49 | 49 | 13 | 13 | 13 |
| 1,147 | walleye | ecological | LOAEC | carnivorous bird hatching success | 62 | 53 | 52 | 52 | 52 | 52 | 14 | 14 | 14 |
| 760 | walleye | ecological | NOAEC | fish | 97 | 79 | 78 | 77 | 77 | 77 | 27 | 26 | 26 |
| 760 | alewife | ecological | NOAEC | fish | 5 | 5 | 4 | 4 | 4 | 4 | 1 | < 1 | < 1 |
| 709 | walleye | ecological | NOAEC | carnivorous bird hatching success | 99 | 52 | 83 | 83 | 83 | 83 | 31 | 31 | 31 |
| 500 | walleye | ecological | LOAEC | mink | 90 | 99 | 99 | 99 | 99 | 99 | 65 | 65 | 65 |
| 500 | alewife | ecological | LOAEC | mink | 21 | 22 | 21 | 21 | 21 | 21 | 4 | 4 | 4 |
| 408 | alewife | ecological | NOAEC | piscivorous bird deformity | 38 | 33 | 32 | 32 | 32 | 32 | 7 | 7 | 7 |
| 121 | walleye | ecological | NOAEC | carnivorous bird deformity | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 |
| 50 | walleye | ecological | NOAEC | mink | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 |
| 50 | alewife | ecological | NOAEC | mink | >100 | >100 | > 100 | >100 | >100 | >100 | > 100 | >100 | >100 |

# Table 8-13 Remedial Action Levels and Attainment of Human Health and Ecological Thresholds (Years until Thresholds Are Met): Green Bay Zone 4

**A. Organized by Fox River Remedial Action Level**

| Media Threshold Concentration (µg/kg) [1] | Media [2] | Threshold Type | Risk Level | Receptor | Fox River No Action / Green Bay No Action | Fox River 5,000 ppb / Green Bay No Action | Fox River 1,000 ppb / Green Bay No Action | Fox River 500 ppb / Green Bay No Action | Fox River 250 ppb / Green Bay No Action | Fox River 125 ppb / Green Bay No Action |
|---|---|---|---|---|---|---|---|---|---|---|
| 7,060 | walleye | human health | CTE $10^{-4}$ cancer risk level | recreational angler | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 3,710 | walleye | human health | CTE $10^{-4}$ cancer risk level | high-intake fish consumer | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 1,176 | walleye | human health | CTE hazard index of 1.0 | recreational angler | 91 | 81 | 86 | 86 | 86 | 86 |
| 1,060 | walleye | human health | RME $10^{-4}$ cancer risk level | recreational angler | 99 | 99 | 99 | 99 | 99 | 99 |
| 710 | walleye | human health | RME $10^{-4}$ cancer risk level | high-intake fish consumer | >100 | >100 | > 100 | >100 | >100 | >100 |
| 706 | walleye | human health | CTE $10^{-5}$ cancer risk level | recreational angler | >100 | >100 | > 100 | >100 | >100 | >100 |
| 588 | walleye | human health | CTE hazard index of 1.0 | high-intake fish consumer | >100 | >100 | > 100 | >100 | >100 | >100 |
| 371 | walleye | human health | CTE $10^{-5}$ cancer risk level | high-intake fish consumer | >100 | >100 | > 100 | >100 | >100 | >100 |
| 288 | walleye | human health | RME hazard index of 1.0 | recreational angler | >100 | >100 | > 100 | >100 | >100 | >100 |
| 181 | walleye | human health | RME hazard index of 1.0 | high-intake fish consumer | >100 | >100 | > 100 | >100 | >100 | >100 |
| 106 | walleye | human health | RME $10^{-5}$ cancer risk level | recreational angler | >100 | >100 | > 100 | >100 | >100 | >100 |
| 71 | walleye | human health | RME $10^{-5}$ cancer risk level; RME $10^{-6}$ cancer risk level | high-intake fish consumer; recreational angler | >100 | >100 | > 100 | >100 | >100 | >100 |
| 37 | walleye | human health | CTE $10^{-6}$ cancer risk level | high-intake fish consumer | >100 | >100 | > 100 | >100 | >100 | >100 |
| 11 | walleye | human health | RME $10^{-6}$ cancer risk level | recreational angler | >100 | >100 | > 100 | >100 | >100 | >100 |
| 7 | walleye | human health | RME $10^{-6}$ cancer risk level | high-intake fish consumer | >100 | >100 | > 100 | >100 | >100 | >100 |
| 7,600 | walleye | ecological | LOAEC | fish | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 7,600 | alewife | ecological | LOAEC | fish | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 4,083 | alewife | ecological | LOAEC | piscivorous bird deformity | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 3,879 | alewife | ecological | LOAEC | piscivorous bird hatching success | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 2,399 | alewife | ecological | NOAEC | piscivorous bird hatching success | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 1,207 | walleye | ecological | LOAEC | carnivorous bird deformity | 91 | 81 | 80 | 80 | 80 | 80 |
| 1,147 | walleye | ecological | LOAEC | carnivorous bird hatching success | 99 | 95 | 94 | 94 | 94 | 94 |
| 760 | walleye | ecological | NOAEC | fish | 99 | 99 | 99 | 99 | 99 | 99 |
| 760 | alewife | ecological | NOAEC | fish | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 709 | walleye | ecological | NOAEC | carnivorous bird hatching success | >100 | >100 | > 100 | >100 | >100 | >100 |
| 500 | walleye | ecological | LOAEC | mink | >100 | >100 | > 100 | >100 | >100 | >100 |
| 500 | alewife | ecological | LOAEC | mink | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 408 | alewife | ecological | NOAEC | piscivorous bird deformity | 5 | 5 | 5 | 5 | 5 | 5 |
| 121 | walleye | ecological | NOAEC | carnivorous bird deformity | >100 | >100 | > 100 | >100 | >100 | >100 |
| 50 | walleye | ecological | NOAEC | mink | >100 | >100 | > 100 | >100 | >100 | >100 |
| 50 | alewife | ecological | NOAEC | mink | >100 | >100 | > 100 | >100 | >100 | >100 |

# Table 8-13 Remedial Action Levels and Attainment of Human Health and Ecological Thresholds (Years until Thresholds are Met): Green Bay Zone 4 (Continued)

**B. Organized by Green Bay Remedial Action Level**

| Media Threshold Concentration (µg/kg) [1] | Media [2] | Threshold Type | Risk Level | Receptor | Green Bay No Action | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Fox River (ppb) | | | | | |
| | | | | | No Action | 5,000 | 1,000 | 500 | 250 | 125 |
| 7,060 | walleye | human health | CTE $10^{-4}$ cancer risk level | recreational angler | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 3,710 | walleye | human health | CTE $10^{-4}$ cancer risk level | high-intake fish consumer | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 1,176 | walleye | human health | CTE hazard index of 1.0 | recreational angler | 91 | 81 | 86 | 86 | 86 | 86 |
| 1,060 | walleye | human health | RME $10^{-4}$ cancer risk level | recreational angler | 99 | 99 | 99 | 99 | 99 | 99 |
| 710 | walleye | human health | RME $10^{-4}$ cancer risk level | high-intake fish consumer | >100 | >100 | > 100 | >100 | >100 | >100 |
| 706 | walleye | human health | CTE $10^{-5}$ cancer risk level | recreational angler | >100 | >100 | > 100 | >100 | >100 | >100 |
| 588 | walleye | human health | CTE hazard index of 1.0 | high-intake fish consumer | >100 | >100 | > 100 | >100 | >100 | >100 |
| 371 | walleye | human health | CTE $10^{-5}$ cancer risk level | high-intake fish consumer | >100 | >100 | > 100 | >100 | >100 | >100 |
| 288 | walleye | human health | RME hazard index of 1.0 | recreational angler | >100 | >100 | > 100 | >100 | >100 | >100 |
| 181 | walleye | human health | RME hazard index of 1.0 | high-intake fish consumer | >100 | >100 | > 100 | >100 | >100 | >100 |
| 106 | walleye | human health | RME $10^{-5}$ cancer risk level | recreational angler | >100 | >100 | > 100 | >100 | >100 | >100 |
| 71 | walleye | human health | RME $10^{-5}$ cancer risk level; RME $10^{-6}$ cancer risk level | high-intake fish consumer; recreational angler | >100 | >100 | > 100 | >100 | >100 | >100 |
| 37 | walleye | human health | CTE $10^{-6}$ cancer risk level | high-intake fish consumer | >100 | >100 | > 100 | >100 | >100 | >100 |
| 11 | walleye | human health | RME $10^{-6}$ cancer risk level | recreational angler | >100 | >100 | > 100 | >100 | >100 | >100 |
| 7 | walleye | human health | RME $10^{-6}$ cancer risk level | high-intake fish consumer | >100 | >100 | > 100 | >100 | >100 | >100 |
| 7,600 | walleye | ecological | LOAEC | fish | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 7,600 | alewife | ecological | LOAEC | fish | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 4,083 | alewife | ecological | LOAEC | piscivorous bird deformity | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 3,879 | alewife | ecological | LOAEC | piscivorous bird hatching success | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 2,399 | alewife | ecological | NOAEC | piscivorous bird hatching success | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 1,207 | walleye | ecological | LOAEC | carnivorous bird deformity | 91 | 81 | 80 | 80 | 80 | 80 |
| 1,147 | walleye | ecological | LOAEC | carnivorous bird hatching success | 99 | 95 | 94 | 94 | 94 | 94 |
| 760 | walleye | ecological | NOAEC | fish | 99 | 99 | 99 | 99 | 99 | 99 |
| 760 | alewife | ecological | NOAEC | fish | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 709 | walleye | ecological | NOAEC | carnivorous bird hatching success | >100 | >100 | > 100 | >100 | >100 | >100 |
| 500 | walleye | ecological | LOAEC | mink | >100 | >100 | > 100 | >100 | >100 | >100 |
| 500 | alewife | ecological | LOAEC | mink | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 408 | alewife | ecological | NOAEC | piscivorous bird deformity | 5 | 5 | 5 | 5 | 5 | 5 |
| 121 | walleye | ecological | NOAEC | carnivorous bird deformity | >100 | >100 | > 100 | >100 | >100 | >100 |
| 50 | walleye | ecological | NOAEC | mink | >100 | >100 | > 100 | >100 | >100 | >100 |
| 50 | alewife | ecological | NOAEC | mink | >100 | >100 | > 100 | >100 | >100 | >100 |

## Table 8-14 RAO 2: Years to Reach Human Health Thresholds for Lower Fox River Remedial Action Levels

| River Reach | Whole Fish Threshold Concentration (µg/kg) | Fish | Risk Level | Receptor | Remedial Action Level (ppb) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | No Action | 5,000 | 1,000 | 500 | 250 | 125 |
| Little Lake Butte des Morts | 288 | walleye | RME hazard index of 1.0 | recreational angler | 51 | 29 | <1 | <1 | <1 | <1 |
| | 181 | walleye | RME hazard index of 1.0 | high-intake fish consumer | 65 | 40 | 4 | <1 | <1 | <1 |
| | 106 | walleye | RME $10^{-5}$ cancer risk level | recreational angler | 84 | 57 | 9 | 5 | <1 | <1 |
| | 71 | walleye | RME $10^{-5}$ cancer risk level | high-intake fish consumer | 100 | 70 | 14 | 10 | 4 | 2 |
| Appleton to Little Rapids | 288 | walleye | RME hazard index of 1.0 | recreational angler | 40 | 26 | 4 | <1 | <1 | <1 |
| | 181 | walleye | RME hazard index of 1.0 | high-intake fish consumer | 55 | 37 | 7 | 5 | 2 | <1 |
| | 106 | walleye | RME $10^{-5}$ cancer risk level | recreational angler | 70 | 42 | 14 | 11 | 7 | 5 |
| | 71 | walleye | RME $10^{-5}$ cancer risk level | high-intake fish consumer | 89 | 65 | 17 | 15 | 9 | 8 |
| Little Rapids to De Pere | 288 | walleye | RME hazard index of 1.0 | recreational angler | 92 | 52 | 9 | 5 | 2 | 2 |
| | 181 | walleye | RME hazard index of 1.0 | high-intake fish consumer | >100 | 67 | 17 | 12 | 7 | 4 |
| | 106 | walleye | RME $10^{-5}$ cancer risk level | recreational angler | >100 | 92 | 30 | 20 | 14 | 9 |
| | 71 | walleye | RME $10^{-5}$ cancer risk level | high-intake fish consumer | >100 | 100 | 42 | 29 | 20 | 15 |
| De Pere to Green Bay | 288 | walleye | RME hazard index of 1.0 | recreational angler | >100 | 79 | 20 | 14 | 8 | 7 |
| | 181 | walleye | RME hazard index of 1.0 | high-intake fish consumer | >100 | 100 | 30 | 20 | 14 | 9 |
| | 106 | walleye | RME $10^{-5}$ cancer risk level | recreational angler | >100 | 100 | 45 | 34 | 20 | 15 |
| | 71 | walleye | RME $10^{-5}$ cancer risk level | high-intake fish consumer | >100 | 100 | 59 | 45 | 29 | 20 |

# Table 8-15 RAO 2: Years to Reach Human Health Thresholds for Green Bay Remedial Action Levels

| Green Bay Zone | Whole Fish Threshold Concentration (µg/kg) | Fish Species | Risk Level | Receptor | Fox River No Action | Fox River 5,000 ppb | Fox River 1,000 ppb | | Fox River 500 ppb | | | Fox River 250 ppb | | | Fox River 125 ppb | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Green Bay No Action | Green Bay No Action | Green Bay (ppb) | | Green Bay (ppb) | | | Green Bay (ppb) | | | Green Bay (ppb) | | |
| | | | | | | | No Action | 1,000 | No Action | 1,000 | 500 | No Action | 1,000 | 500 | No Action | 1,000 | 500 |
| 2 | 288 | walleye | RME hazard index of 1.0 | recreational angler | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 |
| | 181 | walleye | RME hazard index of 1.0 | high-intake fish consumer | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 |
| | 106 | walleye | RME $10^{-5}$ cancer risk level | recreational angler | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 |
| | 71 | walleye | RME $10^{-5}$ cancer risk level | high-intake fish consumer | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 |
| 3A | 288 | walleye | RME hazard index of 1.0 | recreational angler | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 |
| | 181 | walleye | RME hazard index of 1.0 | high-intake fish consumer | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 |
| | 106 | walleye | RME $10^{-5}$ cancer risk level | recreational angler | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 |
| | 71 | walleye | RME $10^{-5}$ cancer risk level | high-intake fish consumer | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 |
| 3B | 288 | walleye | RME hazard index of 1.0 | recreational angler | >100 | >100 | >100 | NC | >100 | NC | 99 | >100 | NC | 99 | >100 | NC | 99 |
| | 181 | walleye | RME hazard index of 1.0 | high-intake fish consumer | >100 | >100 | >100 | NC | >100 | NC | >100 | >100 | NC | >100 | >100 | NC | >100 |
| | 106 | walleye | RME $10^{-5}$ cancer risk level | recreational angler | >100 | >100 | >100 | NC | >100 | NC | >100 | >100 | NC | >100 | >100 | NC | >100 |
| | 71 | walleye | RME $10^{-5}$ cancer risk level | high-intake fish consumer | >100 | >100 | >100 | NC | >100 | NC | >100 | >100 | NC | >100 | >100 | NC | >100 |
| 4 | 288 | walleye | RME hazard index of 1.0 | recreational angler | >100 | >100 | >100 | NC | >100 | NC | NC | >100 | NC | NC | >100 | NC | NC |
| | 181 | walleye | RME hazard index of 1.0 | high-intake fish consumer | >100 | >100 | >100 | NC | >100 | NC | NC | >100 | NC | NC | >100 | NC | NC |
| | 106 | walleye | RME $10^{-5}$ cancer risk level | recreational angler | >100 | >100 | >100 | NC | >100 | NC | NC | >100 | NC | NC | >100 | NC | NC |
| | 71 | walleye | RME $10^{-5}$ cancer risk level | high-intake fish consumer | >100 | >100 | >100 | NC | >100 | NC | NC | >100 | NC | NC | >100 | NC | NC |

**Note:**
NC - Not Considered.

# Table 8-16 RAO 3: Years to Reach Ecological Thresholds for Lower Fox River Remedial Action Levels

| River Reach | Media Threshold Concentration (µg/kg) [1] | Media [2] | Risk Level | Receptor | Remedial Action Level (ppb) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | No Action | 5,000 | 1,000 | 500 | 250 | 125 |
| Little Lake Butte des Morts | 4,083 | gizzard shad | LOAEC | piscivorous bird deformity | <1 | <1 | <1 | <1 | <1 | <1 |
| | 3,879 | gizzard shad | LOAEC | piscivorous bird hatching success | <1 | <1 | <1 | <1 | <1 | <1 |
| | 2,399 | gizzard shad | NOAEC | piscivorous bird hatching success | <1 | <1 | <1 | <1 | <1 | <1 |
| | 408 | gizzard shad | NOAEC | piscivorous bird deformity | <1 | <1 | <1 | <1 | <1 | <1 |
| | 121 | carp | NOAEC | carnivorous bird deformity | 100 | 67 | 14 | 9 | <1 | <1 |
| | 50 | carp | NOAEC | piscivorous mammal | >100 | 100 | 29 | 25 | 9 | 7 |
| | 223 | sediment | TEL | sediment invertebrate | >100 | >100 | 60 | 52 | 26 | 21 |
| Appleton to Little Rapids | 4,083 | gizzard shad | LOAEC | piscivorous bird deformity | <1 | <1 | <1 | <1 | <1 | <1 |
| | 3,879 | gizzard shad | LOAEC | piscivorous bird hatching success | <1 | <1 | <1 | <1 | <1 | <1 |
| | 2,399 | gizzard shad | NOAEC | piscivorous bird hatching success | <1 | <1 | <1 | <1 | <1 | <1 |
| | 408 | gizzard shad | NOAEC | piscivorous bird deformity | <1 | <1 | <1 | <1 | <1 | <1 |
| | 121 | carp | NOAEC | carnivorous bird deformity | 71 | 55 | 17 | 15 | 9 | 7 |
| | 50 | carp | NOAEC | piscivorous mammal | 100 | 89 | 34 | 29 | 18 | 15 |
| | 771 | sediment | TEL | sediment invertebrate | 81 | 63 | 28 | 24 | 16 | 13 |
| Little Rapids to De Pere | 4,083 | gizzard shad | LOAEC | piscivorous bird deformity | <1 | <1 | <1 | <1 | <1 | <1 |
| | 3,879 | gizzard shad | LOAEC | piscivorous bird hatching success | <1 | <1 | <1 | <1 | <1 | <1 |
| | 2,399 | gizzard shad | NOAEC | piscivorous bird hatching success | <1 | <1 | <1 | <1 | <1 | <1 |
| | 408 | gizzard shad | NOAEC | piscivorous bird deformity | 2 | <1 | <1 | <1 | <1 | <1 |
| | 121 | carp | NOAEC | carnivorous bird deformity | >100 | 76 | 22 | 12 | 8 | 4 |
| | 50 | carp | NOAEC | piscivorous mammal | >100 | >100 | 43 | 31 | 25 | 15 |
| | 596 | sediment | TEL | sediment invertebrate | >100 | >100 | 46 | 33 | 28 | 16 |
| De Pere to Green Bay | 4,083 | alewife | LOAEC | piscivorous bird deformity | <1 | <1 | <1 | <1 | <1 | <1 |
| | 3,879 | alewife | LOAEC | piscivorous bird hatching success | <1 | <1 | <1 | <1 | <1 | <1 |
| | 2,399 | alewife | NOAEC | piscivorous bird hatching success | <1 | <1 | <1 | <1 | <1 | <1 |
| | 408 | alewife | NOAEC | piscivorous bird deformity | 100 | 9 | <1 | <1 | <1 | <1 |
| | 121 | carp | NOAEC | carnivorous bird deformity | >100 | 79 | 20 | 14 | 7 | 5 |
| | 50 | carp | NOAEC | piscivorous mammal | >100 | 100 | 45 | 34 | 17 | 14 |
| | 632 | sediment | TEL | sediment invertebrate | >100 | 93 | 37 | 23 | 13 | 6 |

**Notes:**

[1] Sediment concentration is presented in units of mg/kg OC.

[2] Fish concentrations are whole body.

# Table 8-17 RAO 3: Years to Reach Ecological Thresholds for Green Bay Remedial Action Levels

| Green Bay Zone | Threshold Type | Fish Species | Thresholds Name | Whole Fish Threshold Concentration (µg/kg) | Fox River No Action | Fox River 5,000 ppb | Fox River 1,000 ppb | | Fox River 500 ppb | | | Fox River 250 ppb | | | Fox River 125 ppb | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Green Bay No Action | Green Bay No Action | Green Bay (ppb) | | Green Bay (ppb) | | | Green Bay (ppb) | | | Green Bay (ppb) | | |
| | | | | | | | No Action | 1,000 | No Action | 1,000 | 500 | No Action | 1,000 | 500 | No Action | 1,000 | 500 |
| 2 | Ecological | alewife | Forster's tern deform. LOAEC | 4,083 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| | | alewife | Forster's tern hatch suc. LOAEC | 3,879 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| | | alewife | Forster's tern hatch suc. NOAEC | 2,399 | 30 | 24 | 23 | 3 | 23 | < 1 | < 1 | 23 | < 1 | < 1 | 23 | < 1 | < 1 |
| | | alewife | Forster's tern deform. NOAEC | 408 | >100 | >100 | >100 | 30 | >100 | 29 | 26 | >100 | 28 | 25 | >100 | 28 | 25 |
| | | walleye | bald eagle deform. NOAEC | 121 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 |
| | | walleye | mink NOAEC | 50 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 |
| | | alewife | mink NOAEC | 50 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 |
| 3A | Ecological | alewife | Forster's tern deform. LOAEC | 4,083 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| | | alewife | Forster's tern hatch suc. LOAEC | 3,879 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| | | alewife | Forster's tern hatch suc. NOAEC | 2,399 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| | | alewife | Forster's tern deform. NOAEC | 408 | 51 | 44 | 43 | 11 | 43 | 11 | 8 | 43 | 11 | 8 | 43 | 11 | 8 |
| | | walleye | bald eagle deform. NOAEC | 121 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 |
| | | walleye | mink NOAEC | 50 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 |
| | | alewife | mink NOAEC | 50 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 |
| 3B | Ecological | alewife | Forster's tern deform. LOAEC | 4,083 | < 1 | < 1 | < 1 | NC | < 1 | NC | < 1 | < 1 | NC | < 1 | < 1 | NC | < 1 |
| | | alewife | Forster's tern hatch suc. LOAEC | 3,879 | < 1 | < 1 | < 1 | NC | < 1 | NC | < 1 | < 1 | NC | < 1 | < 1 | NC | < 1 |
| | | alewife | Forster's tern hatch suc. NOAEC | 2,399 | < 1 | < 1 | < 1 | NC | < 1 | NC | < 1 | < 1 | NC | < 1 | < 1 | NC | < 1 |
| | | alewife | Forster's tern deform. NOAEC | 408 | 38 | 33 | 32 | NC | 32 | NC | 7 | 32 | NC | 7 | 32 | NC | 7 |
| | | walleye | bald eagle deform. NOAEC | 121 | >100 | >100 | >100 | NC | >100 | NC | >100 | >100 | NC | >100 | >100 | NC | >100 |
| | | walleye | mink NOAEC | 50 | >100 | >100 | >100 | NC | >100 | NC | >100 | >100 | NC | >100 | >100 | NC | >100 |
| | | alewife | mink NOAEC | 50 | >100 | >100 | >100 | NC | >100 | NC | >100 | >100 | NC | >100 | >100 | NC | >100 |
| 4 | Ecological | alewife | Forster's tern deform. LOAEC | 4,083 | < 1 | < 1 | < 1 | NC | < 1 | NC | NC | < 1 | NC | NC | < 1 | NC | NC |
| | | alewife | Forster's tern hatch suc. LOAEC | 3,879 | < 1 | < 1 | < 1 | NC | < 1 | NC | NC | < 1 | NC | NC | < 1 | NC | NC |
| | | alewife | Forster's tern hatch suc. NOAEC | 2,399 | < 1 | < 1 | < 1 | NC | < 1 | NC | NC | < 1 | NC | NC | < 1 | NC | NC |
| | | alewife | Forster's tern deform. NOAEC | 408 | 5 | 5 | 5 | NC | 5 | NC | NC | 5 | NC | NC | 5 | NC | NC |
| | | walleye | Bald eagle deform. NOAEC | 121 | >100 | >100 | >100 | NC | >100 | NC | NC | >100 | NC | NC | >100 | NC | NC |
| | | walleye | mink NOAEC | 50 | >100 | >100 | >100 | NC | >100 | NC | NC | >100 | NC | NC | >100 | NC | NC |
| | | alewife | mink NOAEC | 50 | >100 | >100 | >100 | NC | >100 | NC | NC | >100 | NC | NC | >100 | NC | NC |

**Note:**
NC - Not Considered

## Table 8-18 RAO 4: Sediment Loading Rates - 30 Years Post-remediation (kg/yr)

| River Reach | Action Level (ppb) | | | | | |
|---|---|---|---|---|---|---|
| | No Action | 5,000 | 1,000 | 500 | 250 | 125 |
| Little Lake Butte des Morts | 11.33 | 6.35 | 0.66 | 0.49 | 0.18 | 0.15 |
| Appleton to Little Rapids | 11.33 | 6.55 | 0.78 | 0.57 | 0.23 | 0.17 |
| Little Rapids to De Pere | 21.25 | 9.54 | 1.46 | 0.94 | 0.54 | 0.32 |
| De Pere to Green Bay | 75.27 | 10.51 | 1.67 | 1.10 | 0.61 | 0.34 |